Draft Appendix D
National Marine Fisheries Service
Programmatic Biological Opinions

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

March 21, 2012

In response, refer to:
2011/06430

Mr. Patrick J. Rutten
NOAA Restoration Center
Southwest Region Supervisor
777 Sonoma Ave., Room 219-A
Santa Rosa, California 95404-6528

Ms. Jane Hicks
Chief, Regulatory Branch
U.S. Army Corps of Engineers
1455 Market Street
San Francisco, California 94103-1398

Dear Mr. Rutten and Ms. Hicks:

This letter transmits NOAA's National Marine Fisheries Service's (NMFS) final biological opinion (enclosure 1) and Essential Fish Habitat (EFH) consultation (enclosure 2) pertaining to the NOAA's Restoration Center's (RC) proposed funding and the U.S. Army Corps of Engineers (Corps) proposed permitting of restoration projects within the National Marine Fisheries Service's Northern California Office jurisdictional area (Program).

The Program is proposed to be effective from 2012 through 2022, and consists of restoration actions that will be funded by NOAA RC in Humboldt, Del Norte, Trinity, Siskiyou, and part of Mendocino counties. The Corps proposes to issue permits for these projects under section 10 of the Rivers and Harbors Act of 1899, and section 404 of the Clean Water Act. The Program will fund, permit, or both, the following restoration activities that are considered in the biological opinion: instream habitat improvements, instream barrier modification for fish passage improvement, bioengineering and riparian habitat restoration, upslope watershed restoration, removal of small dams, creation of off-channel/side-channel habitat features, development of alternative stockwater supply, tailwater collection ponds, water storage tanks, piping ditches, fish screens, headgates, and water measuring devices. Enclosure 3, "Number of sediment producing projects per Hydrologic Unit Code (HUC) 10 per year," and enclosure 4, "Sample Application and Monitoring Checklist" are also enclosed.

The enclosed biological opinion is based on NMFS' review of information provided with NOAA RC's and the Corps' February 2, 2011, request for formal consultation, a biological assessment (BA) for the Program, and several e-mails that occurred during the consultation. The biological opinion addresses potential effects on the following listed species' Evolutionarily Significant

Unit (ESU) or Distinct Population Segment (DPS) and designated critical habitat in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 § et *seq.*):

Southern DPS of Pacific Eulachon
(*Thaleichthys pacificus*)
Threatened (75 FR 13012, March 18, 2010)

Southern Resident Killer Whales DPS
(*Orcinus orca*)
Endangered (70 FR 69903, November 18, 2005)

Southern DPS of North American Green Sturgeon
(*Acipenser medirostris*)
Threatened (71 FR 17757, April 7, 2006)
Designated critical habitat (74 FR 52300, October 9, 2009)

Southern Oregon/Northern California Coast (SONCC) coho salmon ESU
(*Oncorhynchus kisutch*)
Threatened (70 FR 37160, June 28, 2005)
Designated critical habitat (64 FR 24049, May 5, 1999,)

California Coastal (CC) Chinook Salmon ESU
(*O. tsawytscha*)
Threatened (70 FR 37160, June 28, 2005)
Designated critical habitat (70 FR 52488, September 2, 2005)

Northern California (NC) steelhead DPS
(*O. mykiss*)
Threatened (71 FR 834, January 5, 2006,)
Designated critical habitat (70 FR 52488, September 2, 2005)

NMFS concluded that the project, as proposed, is not likely to adversely affect southern DPS of Pacific Eulachon, southern DPS of Green Sturgeon, or Southern Resident Killer Whales; or designated critical habitat for Southern eulachon, or Southern Green Sturgeon. Based on the best scientific and commercial information available, NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of SONCC coho salmon, CC Chinook salmon, or NC steelhead; and is not likely to result in the destruction or adverse modification of designated critical habitat for SONCC coho salmon, CC Chinook salmon, or NC steelhead.

NMFS expects the proposed action will result in incidental take of SONCC coho salmon, CC Chinook salmon, and NC steelhead. An incidental take statement is included with the enclosed biological opinion. The incidental take statement includes non-discretionary reasonable and prudent measures and terms and conditions that are expected to reduce the amount or extent of incidental take of SONCC coho salmon, CC Chinook salmon, or NC steelhead occurring as a result of the proposed action. Additionally, two discretionary conservation recommendations are provided in the biological opinion.

The enclosed EFH consultation (enclosure 2) was prepared pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The proposed action includes areas identified as EFH for coho salmon and Chinook salmon under the Pacific Coast Salmon Fishery Management Plan. Based on our analysis, NMFS concludes that the project would adversely affect EFH for coho salmon and Chinook salmon, however, the proposed project contains adequate measures to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH. NMFS has no additional EFH conservation recommendations to provide at this time. This concludes EFH consultation for the proposed project. Pursuant to 50 CFR 600.920(l), the Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH.

If you have any questions regarding these consultations, please contact Shari Anderson on my staff at (707) 825-5186.

Sincerely,

For

Rodney R. McInnis
Regional Administrator

Enclosures

cc: Bob Pagliuco, NOAA RC, Arcata, CA
Kelly Reid, Corps, Eureka, CA
Copy to Administrative File:15422SWR2009AR00566

Enclosure 1

BIOLOGICAL OPINION

ACTION AGENCY:	NOAA Restoration Center United States Army Corps of Engineers
ACTION:	Program to fund, permit (or both), restoration projects within the NOAA Restoration Center's Northern California Office jurisdictional area
CONSULTATION CONDUCTED BY:	National Marine Fisheries Service, Southwest Region
TRACKING NUMBER:	151422SWR2009AR00566
DATE ISSUED:	**March 21, 2012**

I. CONSULTATION HISTORY

On February 2, 2011, NOAA's National Marine Fisheries Service (NMFS) received a letter from the NOAA Restoration Center (RC) requesting formal consultation pursuant to section 7(a)(2) of the Endangered Species Act (ESA), as amended (16 U.S.C. § 1531 et seq.) and its implementing regulations (50 CFR § 402). The request for consultation was in regards to a program that will fund restoration actions within the NOAA Restoration Center's Arcata Office jurisdictional area for a period of 10 years. The consultation concerns the effects of the proposed program and associated restoration activities on the Southern Oregon/Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*), threatened Northern California (NC) steelhead (*O. mykiss*), threatened California Coastal (CC) Chinook (*O. tshawytscha*), threatened southern Distinct Population Segment (DPS) of Pacific eulachon (*Thaleichthys pacificus*), endangered Southern Resident Killer Whales (*Orcinus orca*); and designated critical habitat for SONCC coho salmon, NC steelhead, CC Chinook, Southern eulachon, and Southern Green Sturgeon (*Acipenser medirostris*). Included with the request for consultation was a biological assessment (NOAA 2011). A subsequent letter was received on February 23, 2011, from the U.S. Army Corps of Engineers (Corps), acknowledging their participation in the program, identified NOAA RC as the lead action agency, and requested initiation of consultation.

Individuals from Southern DPS of Green Sturgeon or the Southern DPS of Pacific eulachon are not likely to be present in the action area during the implementation of habitat restoration projects (the summer low-flow period), and because projects won't be implemented in the estuary and sediment effects are minimized, effects to the Eulachon's designated critical habitat are expected to be negligible. Therefore, Southern DPS Green Sturgeon, the Southern DPS of Pacific eulachon, and their critical habitats are not likely to be adversely affected by the proposed action and will not be further considered in this biological opinion. In addition, based on the beneficial effects of restoration projects to anadromous salmonids, NMFS anticipates the proposed action will not adversely affect the Endangered Southern Resident killer whales, but is expected to have a beneficial effect on local populations of salmon, which are one of their major food sources. Because the project is not likely to adversely affect Southern Resident Killer Whales, they will not be further considered in this biological opinion.

A complete administrative record for this consultation is on file at NMFS' Northern California Office, Arcata, CA.

II. DESCRIPTION OF THE PROPOSED ACTION

The NOAA RC proposes to fund restoration projects in Humboldt, Del Norte, Trinity, Siskiyou, and a part of Mendocino counties and the Corps proposes to issue permits under section 10 of the Rivers and Harbors Act of 1899, and section 404 of the Federal Water Pollution Control Act, as amended (Clean Water Act (CWA)), for the restoration projects (figure 1) as necessary. The restoration projects will be within the NOAA RC's Northern California Office jurisdictional area and include projects funded, permitted, or both from 2012 through 2022. Proposed restoration projects are categorized as follows: instream habitat improvements, instream barrier modification for fish passage improvement, bioengineering and riparian habitat restoration, upslope watershed restoration, removal of small dams, creation of off-channel/side channel habitat features, development of alternative stockwater supply, tailwater collection ponds, water storage tanks, piping ditches, fish screens, and headgates, and water measuring devices.

NOAA RC staff in Arcata, California will administer and oversee the program to facilitate implementation of the restoration projects occurring in the Northern California Office of NOAA's National Marine Fisheries Service (Program). This biological opinion will cover projects either funded by the NOAA RC, those that receive a Corps permit under the Program, or both. All restoration projects included in the Program and covered by this biological opinion will be subject to the administration process described in Section B, *Oversight and Administration*. Restoration projects may be submitted to the Program by either the Corps or the NOAA RC. The NOAA RC will take the lead for the Program and participate in the screening of individual projects under consideration for inclusion in the Program, and will track implementation of individual projects. Such tracking will include documentation and reporting to the NMFS Northern California Office of any incidental take that results from individual projects under this Program.

A. Action Area

The action area is defined as all areas 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 includes all stream channels, riparian areas, and hydrologically linked upslope areas that will be affected by the implementation of the proposed restoration projects that are authorized under the Program. Qualifying restoration projects occurring within the NOAA RC's Northern California Office boundaries will be implemented under the Program (figure 1). Effects resulting from most restoration activities will be restricted to the immediate restoration project site, while some activities may result in turbidity for a short distance downstream. The specific extent of effects from each individual habitat restoration project will vary depending on project type, specific project methods, and site conditions.

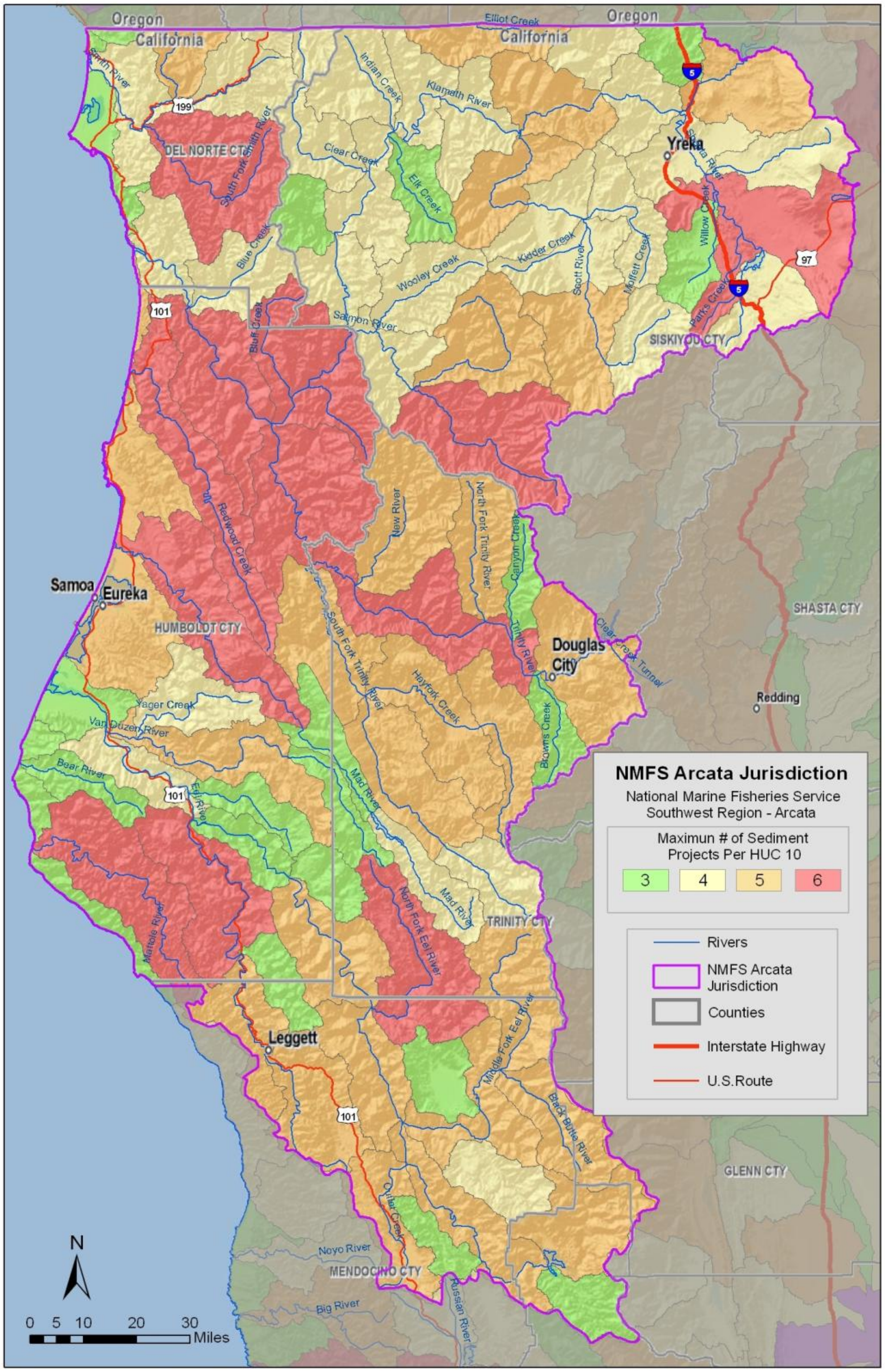

Figure 1. Map showing the action area of the proposed Program. Shaded regions indicate maximum number of sediment producing projects per HUC 10 (described in detail under section D. *Sideboards, Minimization Measures, and other Requirements*)

B. Oversight and Administration

In this section we outline the process for administration of the Program. To assist NOAA RC staff with the tracking and oversight of implemented Program projects, a Team comprised of NOAA RC (Arcata Office) staff and Corps (Eureka Office) staff was established. The Team will play an integral role in tracking both the overall number and locations of projects authorized under the Program each year, and ensure that the limits outlined below in section D "*Sideboards, Minimization Measures, and Other Requirements"* are adhered to. Additionally, the Team will maintain a database, tracking the overall incidental take of listed species that occurs during implementation of individual projects and the Program. The following summarizes the process for reviewing individual projects for consideration and authorization under the Program.

1. <u>Submittal of Project Applications to be Considered for Authorization Under the Program</u>

Project applications will come through the NOAA RC, or through the Corps at the time of application for a CWA section 404 permit, a Rivers and Harbors Act section 10 permit, or both. Applications for proposed projects will be submitted by the project applicant to the Team for consideration in the Program.

2. <u>Timeline for Submittal and Review of Project Applications</u>

Project applications will likely be submitted throughout the year to the Team, and distributed to the Team for review. As described below, Corps staff may request assistance from NOAA RC for input on whether projects are consistent with the Program. The Team will then bundle projects to be covered under the Program for review and processing (as described in the following steps) approximately twice a year, possibly in the early Winter (December/January) and Spring (March/April).

3. <u>Submittal Requirements</u>

Projects that either fall under a NOAA RC funding source or a Corps permit may be submitted to the Program using a standard application form provided by a Team member. The NOAA RC and the Corps will determine which projects are consistent with the Program requirements. Project proposals must supply sufficient information about their project to allow the Team to determine whether or not the project qualifies for coverage under the Program. Detailed submittal requirements are described in this biological opinion's subsection *Monitoring and Reporting Requirements*.

4. <u>Initial Project Screening</u>

The NOAA RC will be the first level of review in screening potential NOAA RC-funded projects for authorization under the Program. The NOAA RC will determine whether a proposed project comports to the conditions of the Program.

The Corps will be the first level of review in screening potential projects where the applicant applied for a Corps permit for authorization under the Program. The Corps will determine whether the proposed project comports to the conditions of the Program.

The Team will use a pre-established checklist (appendix B) to help determine if a proposed project fits within the parameters of the Program. Once projects have passed through the initial project screening by the Team, and any projects that do not fit are either further clarified or developed by the project proponent and resubmitted, the Team will compile a report (project summary sheet/table) for the bundled projects.

5. <u>Corps and NOAA RC Authorization and Project Construction</u>

With the Corps' and NOAA RC's written approval, authorized (*i.e.*, funded, permitted) projects are implemented by the applicants, incorporating applicable guidelines and required protection measures (described below).

6. <u>Post-Construction Implementation Monitoring and Reporting</u>

Applicants are required to conduct post-construction implementation monitoring and associated reporting requirements for their projects authorized under the Program. Monitoring and reporting will include photo-documentation (consistent with the pre-construction monitoring requirements), as-builts (post construction plans on engineered projects); evidence of implementation of required avoidance, minimization, and mitigation measures; and number (by species) of fish relocated and any fish mortality that resulted from the project. The applicant(s) shall submit this information to the Team within 6 months post-construction for data assembly—as described below.

7. <u>Project Tracking and Annual Report</u>

The Team will maintain a database of the monitoring information collected (*Monitoring and Submittal Requirements)* for all projects implemented under the Program. In order to monitor the effects to the protected ESUs, DPSs and critical habitats over the life of the Program, and to track incidental take of listed species, the Team will annually prepare and submit to the NMFS Northern California Office a report of the previous year's restoration activities. The annual report will contain information (as described in detail in section E. *Monitoring and Reporting Requirements*) about projects implemented during the previous construction season as well as projects implemented in prior years under the Program.

C. Description of Restoration Project Types

Habitat restoration projects authorized through the Program will be designed and implemented consistent with techniques and minimization measures presented in CDFG's *California Salmonid Stream Habitat Restoration Manual, Third Edition, Volume II* with four chapters *(Part IX: Fish Passage Evaluation at Stream Crossings, Part X: Upslope Assessment and Restoration Practices, Part XI: Riparian Habitat Restoration, and Part XII: Fish Passage Design and Implementation)* added in 2003, 2004, and 2009, respectively (Flosi et al. 1998, hereafter referred to as CDFG Manual). The Program requires avoidance and minimization practices for all projects to reduce the potential for ancillary effects to listed species and other riparian and aquatic species. These measures are described in subsection *D. Sideboards, Minimization Measures, and other Requirements.* Program activities are as follows:

1. <u>Instream Habitat Structures and Improvements</u>

Instream habitat structures and improvements are intended to provide predator escape and resting cover, increase spawning habitat, improve migration corridors, improve pool to riffle ratios, and add habitat complexity and diversity. Specific techniques for instream habitat improvement include: (1) placement of cover structures (divide logs, engineered log jams, digger logs, spider logs; and log, root wad, and boulder combinations), boulder structures (boulder weirs, vortex boulder weirs, boulder clusters, and single and opposing boulder-wing-deflectors), (2) log structures (log weirs, upsurge weirs, single and opposing log-wing-deflectors, engineered log jams, and Hewitt ramps), and (3) placement of imported spawning gravel. Implementation of these types of projects may require the use of heavy equipment (*e.g.*, self-propelled logging yarders, excavators, backhoes, helicopters), however, hand labor will be used when possible. Large woody debris (LWD) may also be placed in the stream channel to enhance pool formation and increase stream channel complexity. Projects will include both anchored and unanchored logs, depending on site conditions and wood availability.

2. <u>Barrier Modification for Fish Passage Improvement</u>

Barrier modification projects are intended to improve salmonid fish passage by (1) providing access to upstream habitat, (2) improving access to habitat, and (3) increasing the duration of accessibility (both within and between years). Projects may include those that improve fish passage through existing culverts, bridges, and paved and unpaved fords through replacement, removal, or retrofitting. In particular, these practices may include the use of gradient control weirs upstream or downstream of barriers to control water velocity, water surface elevation, or provide sufficient pool habitat to facilitate jumps, or interior baffles or weirs to mediate velocity and the increased water depth. Weirs may also be used to improve passage in flood control channels (particularly concrete lined channels). The Program also includes log jam modifications to facilitate juvenile and adult fish passage. Implementing these types of projects may require the use of heavy equipment (*e.g.*, self-propelled logging yarders, mechanical excavators, backhoes), however, hand labor will be used when possible.

Part IX of the CDFG Manual, entitled *Fish Passage Evaluation at Stream Crossings*, provides consistent methods for evaluating fish passage through culverts at stream crossings, and will aid in assessing fish passage through other types of stream crossings, such as bridges and paved or hardened fords. The objectives of Part IX are to provide the user with consistent methods for evaluating salmonid passage though stream crossings, ranking criteria for prioritizing stream crossing sites for treatment, treatment options to provide unimpeded fish passage, a stream crossing remediation project checklist, guidance measures to minimize impacts during stream crossing remediation construction, and methods for monitoring the effectiveness of corrective treatments.

The chapter in the CDFG Manual (Part XII), entitled *Fish Passage Design and Implementation*, provides technical guidance for the design of fish passage projects at stream crossings, small dams and water diversion structures. Part XII is intended to:

> guide designers through the general process of selecting a design approach for passage improvement. It provides concepts, a design framework, and procedures to design stream crossings and fishways that satisfy ecological objectives, including: efficient and safe passage of all aquatic organisms and life stages, continuity of geomorphic processes such as the movement of debris and sediment, accommodation of behavior and swimming ability of organisms to be passed, diversity of physical and hydraulic conditions leading to high diversity of passage opportunities, projects that are self-sustaining and durable, and passage of terrestrial organisms that move within the riparian corridor.

Where there is an opportunity to protect salmonids, additional site-specific criteria may be appropriate.

3. Bioengineering and Riparian Habitat Restoration

These projects are intended to improve salmonid habitat through increased stream shading intended to lower stream temperatures, increase future recruitment of LWD to streams, and increase bank stability and invertebrate production. Riparian habitat restoration projects will aid in the restoration of riparian habitat by increasing the number of plants and plant groupings, and will include the following types of projects: natural regeneration, livestock exclusionary fencing, bioengineering, and revegetation. Part XI of the CDFG Manual, *Riparian Habitat Restoration*, contains examples of these techniques.

Reduction of instream sediment will improve fish habitat and fish survival by increasing fish embryo and alevin survival in spawning gravels, reducing injury to juvenile salmonids from high concentrations of suspended sediment, and minimizing the loss of, or reduction in size of, pools from excess sediment deposition. The proposed activities will reduce stream sedimentation from bank erosion by stabilizing stream banks with appropriate site-specific techniques including: boulder-streambank stabilization structures, log-streambank stabilization structures, tree revetment, native plant material revetment, willow wall revetment, willow siltation baffles, brush mattresses, checkdams, brush checkdams, water bars, and exclusionary fencing. Guidelines for stream bank stabilization techniques are described in Part VII of the CDFG Manual, *Project Implementation*. These types of projects usually require the use of heavy equipment (*e.g.*, self-propelled logging yarders, mechanical excavators, backhoes).

4. Upslope Watershed Restoration

Upslope watershed restoration projects are intended to reduce delivery of sediment to anadromous salmonid streams. Part X of the CDFG Manual, *Upslope Assessment and Restoration Practices*, describes methods for identifying and assessing erosion, evaluating appropriate treatments, and implementing erosion control treatments. Road-related upslope watershed restoration projects include decommissioning, upgrading, and storm proofing. Implementation of these types of projects may require the use of heavy equipment (*e.g.*, self-propelled logging yarders, mechanical excavators, backhoes), however, hand labor will be used when possible.

5. Removal of Small Dams (permanent and flashboard)

a. *Project Description*

The CDFG Manual does not cover the removal of small dams, however guidelines and minimization measures have been developed in this proposed action. Types of small dams are permanent, flash board, and seasonal dams with the characteristics listed below. Implementing these types of projects may require the use of heavy equipment (*e.g.*, self-propelled logging yarders, mechanical excavators, backhoes). Dams removed in part or in whole, by the use of explosives are not included in the proposed action.

Dams included in the Program are defined by the California Division of Dam Safety (California Water Code, 2010):

> Any artificial barrier which either (a) is less than 25 feet in height from the natural bed of the stream or watercourse at the downstream toe of the barrier, or from the lowest elevation of the outside limit of the barrier to the maximum possible water storage elevation or (b) was designed to have an impounding capacity of less than 50 acre-feet.

In addition, this Program will only include dam removal that will form a channel at natural grade and shape upstream of the dam, naturally or with excavation, in order to minimize negative effects on downstream habitat. Dam removal projects will (1) have a relatively small volume of sediment available for release, that when released by storm flows, will have minimal effects on downstream habitat, or (2) are designed to remove sediment trapped by the dam down to the elevation of the target thalweg including design channel and floodplain dimensions. This can be accomplished by estimating the natural thalweg using an adequate longitudinal profile (CDFG Manual Part XII *Fish Passage Design and Implementation*) and designing a natural shaped channel that provides the same hydraulic conditions and habitat for listed fish that is provided by the natural channel and has the capacity to accommodate flows up to a 2-year flood.

b. *Minimization Measures*

- All construction will take place out of the wetted channel either by implementing the project from the bank and out of the channel or by constructing coffer dams, removing aquatic species located within the project reach, and dewatering the channel.

- No more than 250 linear feet (125 feet on each side of the channel) of riparian vegetation will be removed. All disturbed areas will be re-vegetated with native grasses, trees, or shrubs.

- All dewatering efforts associated with small dam removal will abide by the applicable minimization measures (Section D. *Sideboards, Minimization Measures, and Other Requirements*).

c. *Data Requirements and Analysis*

- A longitudinal profile of the stream channel thalweg for at least a distance equal to 20 channel widths upstream and downstream of the structure and long enough to establish the natural channel grade, whichever is farther, shall be used to determine the potential for channel degradation (as described in the CDFG Manual).

- A minimum of five cross-sections: one downstream of the structure, three roughly evenly spaced through the reservoir area upstream of the structure, and one upstream of the reservoir area outside of the influence of the structure to characterize the channel morphology and quantify the stored sediment.

- Sediment characterization within the reservoir and within a reference reach of a similar channel to determine the proportion of coarse sediment (>2mm) in the reservoir area and target sediment composition.

- A habitat typing survey (DFG Manual Part III, Habitat Inventory Methods) that maps and quantifies all downstream spawning areas that may be affected by sediment released by removal of the water control structure.

Projects will be deemed ineligible for the program if: (1) sediments stored behind dam have a reasonable potential to contain environmental contaminants [dioxins, chlorinated pesticides, polychlorinated biphenyls (PCB's), or mercury] beyond the freshwater probable effect levels (PELs) summarized in the NOAA Screening Quick Reference Table guidelines or (2) the risk of significant loss or degradation of downstream spawning or rearing areas by sediment deposition is considered to be such that the project requires more detailed analysis. Sites shall be considered to have a reasonable potential to contain contaminants of concern if they are downstream of historical contamination sources such as lumber or paper mills, industrial sites, or intensive agricultural production going back several decades (*i.e.*, since chlorinated pesticides were legal to purchase and use). In these cases, preliminary sediment sampling is advisable.

6. Creation of Off-channel/Side Channel Habitat

a. *Project Description*

The creation of off-channel or side channel habitat is not included in the CDFG Manual, however, guidelines and minimization measures have been developed in this proposed action. Types of side channel or off-channel restoration projects that will be eligible for the Program are:

- Connection of abandoned side channel or pond habitats to restore fish access
- Connection of adjacent ponds, remnants from aggregate excavation
- Connection of oxbow lakes on floodplains that have been isolated from the meandering channel by river management schemes, or channel incision
- Creation of side channel or off-channel habitat with self-sustaining channels
- Improvement of hydrologic connection between floodplains and main channels

Projects that involve the installation of a flashboard dam, head gate or other mechanical structure are not part of the Program. Off channel ponds constructed under this Program will not be used as a point of water diversion. Use of logs or boulders as stationary water level control structures will be allowed.

Restoration projects in this category may include: removal or breaching of levees and dikes, channel and pond excavation, creating temporary access roads, constructing wood or rock tailwater control structures, and construction of LWD habitat features. Implementation of these types of projects may require the use of heavy equipment (*e.g.*, self-propelled logging yarders, mechanical excavators, backhoes).

Information regarding consideration of water supply (channel flow/overland flow/groundwater), water quality, and reliability; risk of channel change; as well as, channel and hydraulic grade will be provided in the project proposal for review by the Team. A good reference document for designing off channel habitat features can be found in "Section 5.1.2 Side Channel/Off Channel Habitat Restoration in the Washington Department of Fish and Wildlife 2004 Stream Habitat Restoration Guidelines" (Saldi-Caromile et al. 2004).

b. *Minimization Measures*

To reduce the effects of turbidity the same measures described in the CDFG Manual for Instream Habitat Improvement projects will be required including:

- Any equipment work within a stream channel shall be performed in isolation from the flowing stream. If there is any flow when the work is done, coffer dams shall be constructed upstream and downstream of the excavation site and divert all flow from upstream of the upstream dam to downstream of the downstream dam. The coffer dams may be constructed from many different materials and methods to meet the objective, for example clean river gravel or sand bags, and may be sealed with sheet plastic. Foreign materials such as sand bags and any sheet plastic shall be removed from the stream upon project completion. In some cases, clean river gravel may be left in the stream, but the coffer dams must be breached to return the stream flow to its natural channel.

- If it is necessary to divert flow around the work site, either by pump or by gravity flow, the suction end of the intake pipe shall be fitted with a fish screen that meets CDFG and NMFS (NMFS 1997a) criteria to prevent entrainment or impingement of small fish. Any turbid water pumped from the work site shall be disposed of in an upland location where it will not drain directly into any stream channel, or treated via settling pond to filter suspended materials before flowing back into the stream.

If the Team determines that a proposed project requires extensive analysis, the project will undergo individual consultation.

7. Developing Alternative Stockwater Supply

a. *Project Description*

Many riparian fencing projects will require the development of off channel watering areas for livestock. These are often ponds that have been excavated and are filled either by rainwater, overland flow, surface diversions or groundwater (either through water table interception or pumping). The Program also covers water lines, watering troughs, and piping used to provide groundwater to livestock.

b. *Minimization Measures*

- Only projects with existing diversions compliant with water laws will be considered. In addition, storage reservoirs will not be greater than 10 acres in size. Flow measuring device installation and maintenance may be required for purposes of accurately measuring and managing pumping rate or bypass conditions set forth in this document or in the water right or special use permit.

- All pump intakes will be screened in accordance with NMFS Southwest Region "Fish Screening Criteria for Salmonids" (NMFS 1997a).
- Stockwater ponds and wells will be located at least 100 feet from the edge of the active channel and are not likely to cause stranding of juvenile salmonids during flood events.

8. Tailwater Collection Ponds

a. *Project Description*

Tailwater is created in flood irrigation operations as unabsorbed irrigation water flows back into the stream. Restoration projects to address tailwater input will construct tailwater capture systems to intercept tailwater before it enters streams. Water held in capture systems, such as a pond, can be reused for future irrigation purposes, therefore reducing the need for additional stream diversions.

b. *Minimization Measures*

- Tailwater collection ponds that do not incorporate return channels to the creek will be located at least 100 feet from the edge of the active channel and are not likely to cause stranding of juvenile salmonids during flood events.

9. Water Storage Tanks

a. Project Description

Water storage tanks could either be filled through rainwater catchment or by surface or groundwater flow. Under this programmatic, all water storage tank projects will be required to enter into a forbearance agreement for at least 10 years, which will provide temporal and quantitative assurances for pumping activities that result in less water withdrawal during summer low flow period. The low flow threshold, measured in cubic feet per second (cfs) season of diversion and season of storage, will be determined in collaboration with CDFG and NOAA RC on a site by site basis. Water storage capacity for the water diversion forbearance period must be of sufficient capacity to provide for all water needs during that time period. For example, if the no-pump period is 105 days (August to November), the diverters must have enough storage to cover any domestic, irrigation, or livestock needs during that time.

b. *Minimization Measures*

- All pump intakes will be properly screened in accordance with NMFS (1996, 1997a) fish screen criteria.

Water conservation projects that include water storage tanks and a Forbearance Agreement for the purpose of storing winter and early spring water for summer and fall use, require registration of water use pursuant to California Water Code § 1228.3, and require consultation with CDFG. Diversions to fill storage facilities during the winter and spring months shall be made pursuant to a Small Domestic Use Appropriation (SDU) filed with the State Water Resources Control Board (SWRCB).

10. <u>Piping Ditches</u>

a. *Project Description*

Piping projects consist of constructing a pipe to transport irrigation water instead of a ditch, thereby reducing evaporation and absorption. Water saved by these projects will remain in the stream for anadromous salmonid benefits. Applicants must demonstrate that they intend to dedicate water for instream beneficial use by filing a *Petition for Instream Flow Dedication* (California Water Code § 1707, 1991) and make progress towards instream dedication**.**

b. *Minimization Measures*

- Only water conservation piping projects that result in a decrease in the diversion rate with a permitted instream dedication of the water saved are included in the Program.
- Landowners will enter an agreement with NOAA RC or the Corps stating that they will maintain the pipe for at least 10 years.

11. <u>Fish Screens</u>

a. *Project Description*

This category includes the installation, operation, and maintenance of the types of fish screens described below, provided they meet the NMFS (1996, 1997a) fish screening criteria. Installing a fish screen usually includes site excavation, forming and pouring a concrete foundation and walls, excavation and installation of a fish bypass pipe or channel, and installation of the fish screen structure. Heavy equipment is typically used for excavation of the screen site and bypass. If the fish screen is placed within or near flood prone areas, typically rock or other armoring is installed to protect the screen. The average area of the bed, channel, and bank disturbed by the installation of a bypass pipe or channel ranges from 40 to 100 square feet, based on past Scott and Shasta river screening projects. Fish screen types include:

- Self-cleaning screens, including flat plate self-cleaning screens, and other self-cleaning designs, including, but not limited to, rotary drum screens and cone screens, with a variety of cleaning mechanisms, consistent with NMFS fish screening criteria (1996, 1997a).

- Non-self-cleaning screens, including tubular, box, and other screen designs consistent with NMFS screening criteria (1996, 1997a).

b. *Minimization Measures*

- All flows will be diverted around work areas as described in the *Requirements for Fish Relocation and Dewatering Activities.*
- Fish removal may be required at project sites and BMPs will be implemented as described in the *Requirements for Fish Relocation and Dewatering Activities.*
- Riparian disturbance will be minimized as described in the *Measures to Minimize Loss or Disturbance of Riparian Vegetation.*

12. <u>Headgates and Water Measuring Devices</u>

a. *Project Description*

Measuring devices are typically installed with the head gate to allow water users to determine the volume of water diverted. Headgate installation projects must clearly demonstrate habitat restoration benefits.

b. *Minimization Measures*

- The application must include, instream and ditch/pump hydraulic calculations showing there is sufficient head to divert maximum diversion flow and bypass flow at minimum stream flow considering head losses at flow measurement devices, fish screens, pipes, open ditches, and headgates.
- Measuring devices must be approved by DWR for watersheds with DWR water master service. Otherwise, measuring devices must conform to the *2001 Bureau of Reclamation Water Measurement Manual* (BOR 2001).
- Design drawings must show structural dimensions in plan, elevation, longitudinal profile, and cross-sectional views along with important component details.
- All flows will be diverted around work areas as described in Section II B. *Requirements for Fish Relocation and Dewatering Activities.*
- Fish removal may be required at project sites and BMPs are described in Section II B. *Requirements for Fish Relocation and Dewatering Activities.*
- Riparian disturbance will be minimized as described in Section II E. *Measures to Minimize Loss or Disturbance of Riparian Vegetation.*

D. Sideboards, Minimization Measures, and other Requirements

A key component of the Program involves the use of sideboards that establish a minimum distance between instream projects and limit the number of instream projects annually within a watershed; relative to the size of the watershed. These sideboards also establish specific, measureable project metrics that assist with the analysis of effects. Additionally, the NOAA RC and Corps have established additional requirements and minimization measures that must be implemented for projects included in the Program. The following are the sideboards, minimization measures, and other requirements proposed by the NOAA RC and Corps for proposed projects:

1. <u>Sideboards for all Water Conservation Projects</u>

a. *Compliance with Water Rights*

All water conservation projects in the Program will require diverters to verify compliance with water rights — as conditioned by a small domestic use or livestock stockpond registration, appropriative water right, or a statement of riparian water use registered with the State Water Resources Control Board and reviewed for compliance with California Fish and Game Code (which may require a Lake or Streambed Alteration Agreement and possibly, a California Environmental Quality Act (CEQA) analysis) by the NOAA RC and the Corps.

b. Site-Specific Restrictions

Restrictions on water diversions from a stream or from hydrologically connected sources (such as springs or groundwater that would contribute to streamflow) are often site-specific. Many of the water conservation projects require change to diversion timing or rates, however, site-specific restrictions to those permits may make a project ineligible to the Program or subject to additional requirements. Diversion permits may have limits on or requirements for:

- Season of diversion
- Rates of diversion
- Possible time-of-day restrictions (avoiding daytime peak in forest evapotranspiration and water temperature, or coordination with other users)
- Fish screen requirements for direct diversions
- Requirements for water storage during high flow periods for use in low flow periods
- Flow or diversion monitoring and reporting.

c. Protection of Instream Flows

The following restrictions are intended to protect instream flows beneficial to fish rearing, spawning, and movement as well as providing habitat native amphibians and other aquatic species. Water conservation projects that involve diversions will need additional information to help the NOAA RC and Corps determine the benefits to fish and if the proposed design is appropriate for the individual project site. The following information will be required:

- Proposed rate of diversion
- Season of diversion
- Diversion records (riparian and appropriative) both upstream and downstream of the project site
- Estimated water use and storage needs for proposed project
- Household/property water conservation plan (low flow shower heads, toilets, etc.)
- Estimated stream gradient and substrate
- Method of accurately measuring diversion rate

2. Engineering Requirements

More complex project types covered by the Program require a higher level of oversight (engineering review, etc.) and review by an engineer. These project types will include:

- Fish passage at stream crossings
- Permanent removal of flashboard dam abutments and sills.
- Small dam removal
- Creation and connection of off channel habitat features

Specific requirements associated with these more complex project types include the following:

- For road-stream crossings and small dam projects, if the stream at the project location was not passable to or was not utilized by all life stages of all listed salmonids in the project area prior to the existence of the road crossing, the project shall pass the life stages and covered salmonid species that historically existed. Retrofitted culverts shall meet the fish passage criteria for the passage needs of the listed species and life stages historically passing through the site prior to the existence of the road crossing, according to CDFG stream crossing criteria (*CDFG Culvert Criteria for Fish Passage* (Appendix IX-A, CDFG Manual).
- All designs for dam removal, off channel habitat features, and fish passage projects will be reviewed by engineers, ensuring the requirements have been met prior to commencement of work. Off channel habitat projects that reduce the potential for stranding using water control structures will be encouraged, but uncertainties in future stream flows and drought conditions cannot be predicted and may result in fish stranding in certain flow conditions.

3. Prohibited Activities

Projects that include any of the following elements would not be authorized under the Program:

- Use of gabion baskets.
- Use of cylindrical riprap (aqualogs).
- Chemically-treated timbers used for any instream structures.
- Activity that substantially disrupts the movement of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the action area.
- Projects that would completely eliminate a riffle/pool complex (*note: there may be some instances where a riffle/pool complex is affected/modified by a restoration project [i.e. a culvert removal that affects an existing pool]. These types of projects would be allowed under the Program).*

4. Limits on Area of Disturbance for Individual Projects

a. *Stream Dewatering*

Maximum length of stream that can be dewatered is 1000 feet.

b. *Upslope Disturbance (raw dirt, tree removal, canopy cover reduction)*

- The disturbance footprint for any individual project staging area may not exceed 0.25 acres.
- Native trees with defects, snags >16 in. diameter at breast height (dbh) and 20 ft high, cavities, leaning toward the stream channel, nests, late seral characteristics, or > 36 in. dbh will be retained. In limited cases removal will be permitted if trees/snags are growing in culvert fill and need to be removed during the crossing upgrade or removal.
- Downed trees (logs) >24 in. dbh and 10-ft-long will be retained on upslope sites.
- The general construction season will be from June 15 to November 1. Restoration, construction, fish relocation, and dewatering activities within any wetted and/or flowing creek channel shall only occur within this period.

c. *Buffer Between Projects Implemented in the Same Year*

All projects implemented in the same year will maintain an 800 ft downstream buffer from any other sediment producing projects proposed for implementation that same year under the Program.

6. Limit on Total Number of Projects Annually

Up to 60 projects may be authorized (via NOAA RC funding, Corps permit, or both) each year under the Program. There will also be an annual per-watershed limitation of projects occurring in any one HUC 10 watershed per year to be authorized under this Program. The number of sediment-producing projects (*i.e.*, instream habitat improvement, instream barrier removal, stream bank stabilization, fish passage improvement, removal of small dams, creation of off-channel/side channel habitat, upslope road work, and fish screen construction) will be limited per HUC 10 by the watershed size (table 1). When defining the sideboard that restricts the number of projects per HUC 10, road decommissioning projects are considered to be one project regardless of the intensity of the project. A list of all HUC 10 watersheds and the number of sediment producing projects allowed based on the restrictions described in table 1 can be found in appendix A.

Table 1. Maximum Number of Sediment-Producing Projects per HUC 10 Watersheds

HUC 10 mi.^{2}	**Max. # of Sediment-Producing Projects**	**Scenarios for Sediment-Producing Projects**
<50	2	1 project per 9.1 mi.^{2}
50-100	3	1 project per 17.3 mi.^{2}
100-150	4	1 project per 25.0 mi.^{2}
150-250	5	1 project per 30.3 mi.^{2}
250-350	6	1 project per 40.9 mi.^{2}
>350	7	1 project per 53.2 mi.^{2}

7. <u>Limit on Distance between Projects</u>

Stream crossing activities within a single project will be limited in accordance to the sideboard which limits distance. Any stream crossing removals in fish bearing streams must be 800 ft (stream distance) apart and crossings in a non-fish-bearing stream must be 500 ft (stream distance) apart.

8. <u>Limits on Removal of Vegetation</u>

Removal of exotic, invasive riparian vegetation in a stream with high water temperatures must be done in a manner to avoid creation of additional temperature loading to fish-bearing streams. If a stream has a 7-day moving average daily maximum (7DMADM) temperature greater than 17.8 ºC in a coho salmon or steelhead stream, or greater than 18.5 ºC in a steelhead only stream, and vegetation management would reduce overstory shade canopy to the wetted channel, then the practice will not be allowed.

9. <u>Protection Measures</u>

The following protection measures, as they apply to a particular project, shall be incorporated into the project descriptions for individual projects authorized under the Program.

a. *General Protection Measures*

- Work shall not begin until (a) the Corps and/or NOAA RC has notified the applicant to the Program that the requirements of the ESA have been satisfied and that the activity is authorized and (b) all other necessary permits and authorizations are finalized.
- The general construction season shall be from June 15 to November 1. Restoration, construction, fish relocation, and dewatering activities within any wetted or flowing stream channel shall only occur within this period. Revegetation outside of the active channel may continue beyond November 1, if necessary.
- Prior to construction, any contractor shall be provided with the specific protective measures to be followed during implementation of the project. In addition, a qualified biologist shall provide the construction crew with information on the listed species and State Fully Protected Species in the project area, the protection afforded the species by the ESA, and guidance on those specific protection measures that must be implemented as part of the project.
- All activities that are likely to result in negative aquatic effects, including temporary effects, shall proceed through a sequencing of effect reduction: avoidance, reduction in magnitude of effect, and compensation (mitigation). Mitigation may be proposed to compensate for negative effects to waters of the United States. Mitigation shall generally be in kind, with no net loss of waters of the United States on a per project basis. Mitigation work shall proceed in advance or concurrently with project construction.
- Poured concrete shall be excluded from the wetted channel for a period of 30 days after it is poured. During that time the poured concrete shall be kept moist, and runoff from the concrete shall not be allowed to enter a live stream. Commercial sealants may be applied to the poured concrete surface where difficulty in excluding water flow for a long period may occur. If sealant is used, water shall be excluded from the site until the sealant is dry and fully cured according to the manufacturers specifications.
- If the thalweg of the stream has been altered due to construction activities, efforts shall be undertaken to reestablish it to its original configuration1.

b. *Requirements for Fish Relocation and Dewatering Activities*

(1) Guidelines for dewatering. Project activities funded or permitted under the Program may require fish relocation or dewatering activities. Dewatering may not be appropriate for some projects that will result in only minor input of sediment, such as placing logs with hand crews, or installing boulder clusters. Dewatering can result in the temporary loss of aquatic habitat, and the stranding, or displacement of fish and amphibian species. Increased turbidity may occur from

1 Projects that may include activities, such the use of willow baffles, which may alter the thalweg are allowed

disturbance of the channel bed. The following guidelines may minimize potential effects for projects that require dewatering of a stream:

- In those specific cases where it is deemed necessary to work in flowing water, the work area shall be isolated and all flowing water shall be temporarily diverted around the work site to maintain downstream flows during construction.
- Exclude fish from occupying the work area by blocking the stream channel above and below the work area with fine-meshed net or screens. Mesh will be no greater than 1/8 inch diameter. The bottom of a seine must be completely secured to the channel bed. Screens must be checked twice daily and cleaned of debris to permit free flow of water. Block nets shall be placed and maintained throughout the dewatering period at the upper and lower extent of the areas where fish will be removed. Block net mesh shall be sized to ensure salmonids upstream or downstream do not enter the areas proposed for dewatering between passes with the electrofisher or seine.
- Prior to dewatering, determine the best means to bypass flow through the work area to minimize disturbance to the channel and avoid direct mortality of fish and other aquatic vertebrates (as described more fully below under ***General conditions for all fish capture and relocation activities***.
- Coordinate project site dewatering with a qualified biologist to perform fish and amphibian relocation activities. The qualified biologist(s) must possess a valid state of California Scientific Collection Permit as issued by the CDFG and must be familiar with the life history and identification of listed salmonids and listed amphibians within the action area.
- Prior to dewatering a construction site, qualified individuals will capture and relocate fish and amphibians to avoid direct mortality and minimize adverse effects. This is especially important if listed species are present within the project site.
- Minimize the length of the dewatered stream channel and duration of dewatering, to the extent practicable.
- Any temporary dam or other artificial obstruction constructed shall only be built from materials such as sandbags or clean gravel which will cause little or no siltation. Visqueen shall be placed over sandbags used for construction of cofferdams construction to minimize water seepage into the construction areas. Visqueen shall be firmly anchored to the streambed to minimize water seepage. Coffer dams and stream diversion systems shall remain in place and fully functional throughout the construction period.
- When coffer dams with bypass pipes are installed, debris racks will be placed at the bypass pipe inlet. Bypass pipes will be monitored a minimum of two times per day, seven days a week. All accumulated debris shall be removed.
- Bypass pipes will be sized to accommodate, at a minimum, twice the summer baseflow.
- The work area may need to be periodically pumped dry of seepage. Place pumps in flat areas, well away from the stream channel. Secure pumps by tying off to a tree or stake in place to prevent movement by vibration. Refuel in an area well away from the stream channel and place fuel absorbent mats under pump while refueling. Pump intakes shall

be covered with 1/8 inch mesh to prevent potential entrainment of fish or amphibians that failed to be removed. Check intake periodically for impingement of fish or amphibians.

- If pumping is necessary to dewater the work site, procedures for pumped water shall include requiring a temporary siltation basin for treatment of all water prior to entering any waterway and not allowing oil or other greasy substances originating from operations to enter or be placed where they could enter a wetted channel. Projects will adhere to NMFS Southwest Region *Fish Screening Criteria for Salmonids* (NMFS 1997a).
- Discharge sediment-laden water from construction area to an upland location or settling pond where it will not drain sediment-laden water back to the stream channel.
- When construction is complete, the flow diversion structure shall be removed as soon as possible in a manner that will allow flow to resume with the least disturbance to the substrate. Cofferdams will be removed so surface elevations of water impounded above the cofferdam will not be reduced at a rate greater than one inch per hour. This will minimize the probability of fish stranding as the area upstream becomes dewatered.

(2) General conditions for all fish capture and relocation activities:

- Fish relocation and dewatering activities shall only occur between June 15 and November 1 of each year.
- All seining, electrofishing, and relocation activities shall be performed by a qualified fisheries biologist. The qualified fisheries biologist shall capture and relocate listed salmonids prior to construction of the water diversion structures (*e.g.*, cofferdams). The qualified fisheries biologist shall note the number of salmonids observed in the affected area, the number and species of salmonids relocated, where they were relocated to, and the date and time of collection and relocation. The qualified fisheries biologist shall have a minimum of three years field experience in the identification and capture of salmonids, including juvenile salmonids, considered in this biological opinion. The qualified biologist will adhere to the following requirements for capture and transport of salmonids:
    - Determine the most efficient means for capturing fish (*i.e.*, seining, dip netting, trapping, electrofishing). Complex stream habitat generally requires the use of electrofishing equipment, whereas in outlet pools, fish may be concentrated by pumping-down the pool and then seining or dipnetting fish.
    - Notify NMFS one week prior to capture and relocation of salmonids to provide NMFS an opportunity to monitor.
    - Initial fish relocation efforts will be conducted several days prior to the start of construction. This provides the fisheries biologist an opportunity to return to the work area and perform additional electrofishing passes immediately prior to construction. In many instances, additional fish will be captured that eluded the previous day's efforts.
    - In streams with high water temperature, perform relocation activities during morning periods.

- Prior to capturing fish, determine the most appropriate release location(s). Consider the following when selecting release site(s):
    - Similar water temperature as capture location
    - Ample habitat for captured fish
    - Low likelihood of fish reentering work site or becoming impinged on exclusion net or screen.
    - Fish must be released in a nearby location within the same HUC 8 watershed
- Periodically measure air and water temperatures. Cease activities when measured water temperatures exceed 17.8 ºC. Temperatures will be measured at the head of riffle tail of pool interface.

(3) Electrofishing Guidelines. The following methods shall be used if fish are relocated via electrofishing:

- All electrofishing will be conducted according to NMFS *Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act* (2000).
- The backpack electrofisher shall be set as follows when capturing fish:

  Voltage setting on the electrofisher shall not exceed 300 volts.

	Initial	Maximum
A) Voltage:	100 Volts	300 Volts
B) Duration:	500 µs (microseconds)	5 ms (milliseconds)
C) Frequency:	30 Hertz	70 Hertz

- A minimum of three passes with the electrofisher shall be conducted to ensure maximum capture probability of salmonids within the area proposed for dewatering.
- No electrofishing shall occur if water conductivity is greater than 350 microSiemens per centimeter (µS/cm) or when instream water temperatures exceed 17.8 °C. Water temperatures shall be measured at the pool/riffle interface. Direct current (DC) shall be used.
- A minimum of one assistant shall aid the fisheries biologist by netting stunned fish and other aquatic vertebrates.

(4) Seining guidelines. The following methods, shall be used if fish are removed with seines.

- A minimum of three passes with the seine shall be utilized to ensure maximum capture probability of salmonids within the area.
- All captured fish shall be processed and released prior to each subsequent pass with the seine.

- The seine mesh shall be adequately sized to ensure fish are not gilled during capture and relocation activities.

(5) Guidelines for relocation of salmonids. The following methods shall be used during relocation activities associated with either method of capture (electrofishing or seining):

- Salmonid fish shall not be overcrowded into buckets; allowing approximately six cubic inches per young-of-the-year (0+) individual and more for larger fish.
- Every effort shall be made not to mix 0+ salmonids with larger salmonids, or other potential predators. Have at least two containers and segregate 0+ fish from larger age-classes. Place larger amphibians, such as Pacific giant salamanders, in container with larger fish.
- Salmonid predators, such as sculpins (*Cottus sp*.) and Pacific-giant salamanders (*Dicamptodon ensatus)* collected and relocated during electrofishing or seining activities shall be relocated so as to not concentrate them in one area. Particular emphasis shall be placed on avoiding relocation of sculpins and Pacific-giant salamanders into the steelhead and coho salmon relocation pools. To minimize predation on salmonids, these species shall be distributed throughout the wetted portion of the stream so as not to concentrate them in one area.
- All captured salmonids shall be relocated, preferably upstream, of the proposed construction project and placed in suitable habitat. Captured fish shall be placed into a pool, preferably with a depth of greater than two feet with available instream cover.
- All captured salmonids will be processed and released prior to conducting a subsequent electrofishing or seining pass.
- All native captured fish will be allowed to recover from electrofishing before being returned to the stream.
- Minimize handling of salmonids. When handling is necessary, always wet hands or nets prior to touching fish. Handlers will not wear DEET based insect repellants.
- Temporarily hold fish in cool, shaded, aerated water in a container with a lid. Provide aeration with a battery-powered external bubbler. Protect fish from jostling and noise and do not remove fish from this container until time of release.
- Place a thermometer in holding containers and, if necessary, periodically conduct partial water changes to maintain a stable water temperature. If water temperature reaches or exceeds 18 °C. , fish shall be released and rescue operations ceased.
- In areas where aquatic vertebrates are abundant, periodically cease capture, and release at predetermined locations.
- Visually identify species and estimate year-classes of fishes at time of release. Record the number of fish captured. Avoid anesthetizing or measuring fish.
- If more than three percent of the steelhead, Chinook salmon, or coho salmon captured are killed or injured, the project lead shall contact NMFS PRD and CDFG. The purpose of the contact is to allow the agencies a courtesy review of activities resulting in take and to determine if additional protective measures are required. All steelhead, Chinook salmon,

and coho salmon mortalities must be retained, placed in an appropriately sized whirl-pak or zip-lock bag, labeled with the date and time of collection, fork length, location of capture, and frozen as soon as possible. Frozen samples must be retained until specific instructions are provided by NMFS.

c. *Measures to Minimize Disturbance from Instream Construction*

Measures to minimize disturbance associated with instream habitat restoration construction activities are presented below.

- If the stream channel is seasonally dry between June 15 and November 1, construction will only occur during this dry period.
- Debris, soil, silt, excessive bark, rubbish, creosote-treated wood, raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to aquatic life, resulting from project related activities, shall be prevented from contaminating the soil or entering the waters of the United States. Any of these materials, placed within or where they may enter a stream or lake, by the applicant or any party working under contract, or with permission of the applicant, shall be removed immediately. During project activities, all trash that may attract potential predators of salmonids will be properly contained, removed from the work site, and disposed of daily.
- Where feasible, the construction shall occur from the bank, or on a temporary pad underlain with filter fabric.
- Use of heavy equipment shall be avoided in a channel bottom with rocky or cobbled substrate. If access to the work site requires crossing a rocky or cobbled substrate, a rubber tire loader/backhoe is the preferred vehicle. Only after this option has been determined infeasible will the use of tracked vehicles be considered. The amount of time this equipment is stationed, working, or traveling within the creek bed shall be minimized. When heavy equipment is used, woody debris and vegetation on banks and in the channel shall not be disturbed if outside of the project's scope.
- All mechanized equipment working in the stream channel or within 25 feet of a wetted channel shall have a double containment system for diesel and oil fluids. Hydraulic fluids in mechanical equipment working within the stream channel shall not contain organophosphate esters. Vegetable based hydraulic fluids are preferred.
- The use or storage of petroleum-powered equipment shall be accomplished in a manner to prevent the potential release of petroleum materials into waters of the state (Fish and Game Code 5650).
- Areas for fuel storage, refueling, and servicing of construction equipment must be located in an upland location.
- Prior to use, clean all equipment to remove external oil, grease, dirt, or mud. Wash sites must be located in upland locations so wash water does not flow into a stream channel or adjacent wetlands.

- All construction equipment must be in good working condition, showing no signs of fuel or oil leaks. Prior to construction, all mechanical equipment shall be thoroughly inspected and evaluated for the potential of fluid leakage. All mechanical equipment shall be inspected on a daily basis to ensure there are no motor oil, transmission fluid, hydraulic fluid, or coolant leaks. All leaks shall be repaired in the equipment staging area or other suitable location prior to resumption of construction activity.
- Oil absorbent and spill containment materials shall be located on site when mechanical equipment is in operation with 100 feet of the proposed watercourse crossings. If a spill occurs, no additional work shall commence in-channel until (1) the mechanical equipment is inspected by the contractor, and the leak has been repaired, (2) the spill has been contained, and (3) CDFG and NOAA RC are contacted and have evaluated the impacts of the spill.

d. Measures to Minimize Degradation of Water Quality

Construction or maintenance activities for projects covered under the Program may result in temporary increases in turbidity levels in the stream. The following measures will be implemented to reduce the potential for adverse effects to water quality during and post-construction:

(1) General erosion control during construction:

- When appropriate, isolate the construction area from flowing water until project materials are installed and erosion protection is in place.
- Effective erosion control measures shall be in place at all times during construction. Do not start construction until all temporary control devices (*e.g.*, straw bales with sterile, weed free straw, silt fences*)* are in place downslope or downstream of project site within the riparian area. The devices shall be properly installed at all locations where the likelihood of sediment input exists. These devices shall be in place during and after construction activities for the purposes of minimizing fine sediment and sediment/water slurry input to flowing water and detaining sediment-laden water on site. If continued erosion is likely to occur after construction is complete, then appropriate erosion prevention measures shall be implemented and maintained until erosion has subsided. Erosion control devices such as coir rolls or erosion control blankets will not contain plastic netting of a mesh size that would entrain reptiles (esp. snakes) and amphibians.
- Sediment shall be removed from sediment controls once it has reached one-third of the exposed height of the control. Whenever straw bales are used, they shall be sterile and weed free, staked and dug into the ground 12 cm. Catch basins shall be maintained so that no more than 15 cm of sediment depth accumulates within traps or sumps.
- Sediment-laden water created by construction activity shall be filtered before it leaves the settling pond or enters the stream network or an aquatic resource area.

- The contractor/applicant to the Program is required to inspect, maintain or repair all erosion control devices prior to and after any storm event, at 24 hour intervals during extended storm events, and a minimum of every two weeks until all erosion control measures have been completed.

(2) Guidelines for temporary stockpiling:

- Minimize temporary stockpiling of material. Stockpile excavated material in areas where it cannot enter the stream channel. Prior to start of construction, determine if such sites are available at or near the project location. If nearby sites are unavailable, determine location where material will be deposited. Establish locations to deposit spoils well away from watercourses with the potential to delivery sediment into streams supporting, or historically supporting populations of listed salmonids. Spoils shall be contoured to disperse runoff and stabilized with mulch and (native) vegetation. Use devices such as plastic sheeting held down with rocks or sandbags over stockpiles, silt fences, or berms of hay bales, to minimize movement of exposed or stockpiled soils.
- If feasible, conserve topsoil for reuse at project location or use in other areas. End haul spoils away from watercourses as soon as possible to minimize potential sediment delivery.

(3) Minimizing potential for scour:

- When needed, utilize instream grade control structures to control channel scour, sediment routing, and headwall cutting.
- For relief culverts or structures, if a pipe or structure that empties into a stream is installed, an energy dissipater shall be installed to reduce bed and bank scour. This does not apply to culverts in fish bearing streams.
- The toe of rock slope protection used for streambank stabilization shall be placed below the bed scour depth to ensure stability.

(4) Post construction erosion control:

- Immediately after project completion and before close of seasonal work window, stabilize all exposed soil with erosion control measures such as mulch, seeding, and/or placement of erosion control blankets. Remove all artificial erosion control devices after the project area has fully stabilized. All exposed soil present in and around the project site shall be stabilized after construction. Erosion control devices such as coir rolls or erosion control blankets will not contain plastic netting of a mesh size that would entrain reptiles (esp. snakes) and amphibians.
- All bare and/or disturbed slopes (> 100 square ft of bare mineral soil) will be treated with erosion control measures such as hay bales, netting, fiber rolls, and hydroseed as permanent erosion control measures.

- Where straw, mulch, or slash is used as erosion control on bare mineral soil, the minimum coverage shall be 95 percent with a minimum depth of two inches.
- When seeding is used as an erosion control measure, only seeds from native plant species will be used. Sterile (without seeds), weed-free straw, free of exotic weeds, is required when hay or hay bales are used as erosional control measures.

e. Measures to Minimize Loss or Disturbance of Riparian Vegetation

Measures to minimize loss or disturbance to riparian vegetation are described below. The revegetation and success criteria that will be adhered to for projects implemented under this Program that result in disturbance to riparian vegetation are also described below.

(1) Minimizing disturbance:

- Retain as many trees and brush as feasible, emphasizing shade-producing and bank-stabilizing trees and brush.
- Prior to construction, determine locations and equipment access points that minimize riparian disturbance. Avoid entering unstable areas. Use project designs and access points that minimize riparian disturbance without affecting less stable areas, which may increase the risk of channel instability.
- Minimize soil compaction by using equipment with a greater reach or that exerts less pressure per square inch on the ground than other equipment, resulting in less overall area disturbed or less compaction of disturbed areas.
- If riparian vegetation is to be removed with chainsaws, consider using saws that operate with vegetable-based bar oil.

(2) Revegetation and success criteria:

- Any stream bank area left barren of vegetation as a result of the implementation or maintenance of the practices shall be restored to a natural state by seeding, planting, or other means with native trees, shrubs, or grasses prior to November 15 of the project year. Barren areas shall typically be planted with a combination of willow stakes, native shrubs and trees and/or erosion control grass mixes.
- Native plant species shall be used for revegetation of disturbed and compacted areas. The species used shall be specific to the project vicinity or the region of the state where the project is located, and comprise a diverse community structure (plantings shall include both woody and herbaceous species).
- For projects where re-vegetation is implemented to compensate for riparian vegetation impacted by project construction, a re-vegetation monitoring report will be required after 5 years to document success. Success is defined as 70 percent survival of plantings or 70 percent ground cover for broadcast planting of seed after a period of 3 years. If revegation efforts will be passive (*i.e.*, natural regeneration), success will be defined as

total cover of woody and herbaceous material equal to or greater than pre-project conditions. If at the end of five years, the vegetation has not successfully been re-established, the project applicant to the Program will be responsible for replacement planting, additional watering, weeding, invasive exotic eradication, or any other practice, to achieve the revegetation requirements. If success is not achieved within the first 5 years, the project applicant will need to prepare a follow-up report in an additional 5 years. This requirement will proceed in 5 year increments until success is achieved.

- All plastic exclusion netting placed around plantings will be removed after 3 years.

f. Measures to Minimize Impacts to Roads in Project Area

When defining the sideboard which restricts the number of projects per HUC 10 (Table 1), road decommissioning projects are considered to be one project; however, intensity of the project is buffered by the sideboards related to road-stream crossing removals, a sediment-producing activity.

Stream crossing activities within the project will be limited in accordance to the sideboard which limits distance to minimize cumulating sediment effects. Any stream crossing removals in a fish bearing stream must be 800 ft apart and crossings in a non-fish-bearing stream must be 500 ft apart.

Upon the completion of restoration activities, roads within the riparian zone damaged by the permitted activity shall be weather proofed according to measures as described in *Handbook for Forest and Ranch Roads* by Weaver and Hagans (1994) of Pacific Watershed Associates and in Part X of the CDFG Manual entitled "*Upslope Assessment and Restoration Practices.*" The following are some of the methods that may be applied to roads impacted by project activities implemented under this Program.

- Establish waterbreaks (*e.g.*, waterbars and rolling dips) on all seasonal roads, skid trails, paths, and fire breaks by October 15. Do not remove waterbreaks until May 15.
- Maximum distance between waterbreaks shall not exceed the following standards: (1) 100 feet for road or trail gradients less than 10 percent slope; (2) 75 feet for road or trail gradients from 11 to 25 percent; (3) 50 feet for road or trail gradients from 26 to 50 percent slope; and (4) 50 feet for road or trail gradients greater than 50 percent slope. Depending on site-specific conditions more frequent intervals may be required to prevent road surface rilling and erosion.
- Locate waterbreaks to allow water to be discharged onto some form of vegetative cover, slash, rocks, or less erodible material. Do not discharge waterbreaks onto unconsolidated fill.
- Waterbreaks shall be cut diagonally a minimum of six inches into the firm roadbed, skid trail, or firebreak surface and shall have a continuous firm embankment of at least six inches in height immediately adjacent to the lower edge of the waterbreak cut.

- The maintenance period for waterbreaks and any other erosion control facilities shall occur after every major storm event for the first year after installation.
- Rolling-dips are preferred over waterbars. Waterbars shall only be used on unsurfaced roads where winter use (including use by bikes, horses, and hikers) will not occur.
- After the first year of installation, erosion control facilities shall be inspected for failure prior to the winter period (October 15) after the first major storm event, and prior to the end of the winter period (May 15). If the erosion controls have failed, additional erosion control elements will be installed to the project site.
- Applicant will establish locations to deposit spoils well away from watercourses with the potential to delivery sediment into streams supporting, or historically supporting populations of listed salmonids. Spoils shall be contoured to disperse runoff and stabilized with mulch and (native) vegetation.
- No berms are allowed on the outside of the road edge.
- No herbicides shall be used on vegetation on inside ditches.

E. Monitoring and Reporting Requirements

1. <u>Pre-Project Monitoring and Submittal Requirements</u>

The following information will be collected by the Program applicants with assistance from qualified biologists. Program applicants will submit the following information either to the Corps (as part of their application for a Corps Permit) or directly to NOAA RC (for NOAA RC funded projects) for project tracking and data reporting requirements. Program applicants will be responsible for obtaining any other necessary permits or authorizations from appropriate agencies before the start of project including, but not limited to a State Water Quality 401 Certification and local County permits. Any modification of the streambed, bank or channel requires notification to CDFG under the Lake or Streambed Alteration program. For all projects that do not meet the requirement of standard exemptions, project review under CEQA is likely to be necessary.

- Pre-project photo monitoring data (per CDFG's guidelines).
- Project Description:
    - Project problem statement,
    - Project goals and objectives, etc.
    - Watershed context.
    - Description of the type of project and restoration techniques utilized (culvert replacement, instream habitat improvements, etc.).
    - Project dimensions.
    - Description of Construction Activities Anticipated (types of equipment, timing, staging areas or access roads required).

    - If dewatering of the work site will be necessary, description of temporary dewatering methods including qualified individual who will be onsite to transport protected salmonids.
    - Construction start- and end-dates.
    - Estimated number of creek crossings and type of vehicle.
    - Materials to be used.
    - When vegetation will be affected as a result of the project, (including removal and replacement), provide a visual assessment of dominant native shrubs and trees, approximate species diversity, and approximate acreage.
    - Description of existing site conditions and explanation of how proposed activities improve or maintain these conditions for steelhead or coho move within the natural variability needed to support these species.
    - Description of key habitat elements (i.e., temperature; type: pool, riffle, flatwater; estimate of instream shelter and shelter components; water depth; dominant substrate type, etc.) for coho and steelhead in project area.
- Description of applicable minimization and avoidance measures incorporated into the individual project.
    - Description of any proposed deviations from that authorized in the BA will be clearly described. It is likely that any proposed deviations from the activities described in the *Proposed Action* subsection (above) or the required protection measures described (above), will result in the project not being covered under this Program and would require individual consultation.
    - Individual project applicants will be required to submit a proposed monitoring plan for the project describing how they will ensure compliance with the applicable monitoring requirements described in this Program description (revegetation, etc.), including the source of funding for implementation of the monitoring plan.
    - For projects that may result in incidental take of coho; (*i.e.* that will require dewatering and fish relocation activities in a stream historically known to support coho), the applicant will also need to comply with the requirements of the California Endangered Species Act (CESA). CESA requires that impacts be minimized and fully mitigated and that funding for implementation is assured. Thus, for projects that have grant funding for implementation, the funding assurance shall be the grant/agreement itself, showing monies earmarked for implementation of necessary protection measures during implementation and follow-up monitoring, or another mechanism approved by NOAA Fisheries and CDFG in writing. For projects that have no such grant funding, the applicant shall be required to provide security in the form of an Irrevocable Letter of Credit issued by a bank or other financial institution giving CDFG access to an account set up with the security deposit in an amount approved in writing by NOAA Fisheries and CDFG. The funding security will be held until the required measures have been successfully implemented.
    - The applicant will sign a "checklist" of project conditions, verifying that they are agreeing to adhere to during project design and implementation (Appendix B).

2. Post Construction Monitoring and Reporting Requirements

Implementation monitoring will be conducted for all projects implemented under the proposed Program. Following construction, individual applicants will submit a post-construction, implementation report to the NOAA RC and the Corps. The implementation report will also be sent to CDFG. Submittal requirements will include project as-built plans describing post implementation conditions and photo documentation of project implementation taken before, during, and after construction utilizing CDFG photo monitoring protocols. For fish relocation activities, the report will include: all fisheries data collected by a qualified fisheries biologist which shall include the number of listed salmonids killed or injured during the proposed action, the number and size (in millimeters) of listed salmonids captured and removeda and any effects of the proposed action on listed salmonids not previously considered.

a. *Monitoring Requirements for Off-channel/Side Channel Habitat Features*

All off channel/side channel habitat projects included in the Program will require an additional level of physical and biological monitoring. In addition to the information collected during the pre-project monitoring and submittal requirements (above), the following information will also be collected by the Program applicants. Program applicants will submit the following information to the NOAA RC to help further understand these project types:

- Pre and post project photo monitoring data (per CDFG's guidelines)
- Project Description:
    - Project problem statement
    - Project goals and objectives, etc.
    - Watershed context
    - Description of the type of off channel feature and restoration techniques utilized
    - Project dimensions
    - Description of outlet control feature (if present)
    - If dewatering of the work site will be necessary, description of temporary dewatering methods including qualified individual who will be onsite to transport protected salmonids
    - Construction start and end dates
    - Materials to be used
    - When vegetation will be affected as a result of the project, (including removal and replacement), provide a visual assessment of dominant native shrubs and trees, approximate species diversity, and approximate acreage
    - Description of existing site conditions and explanation of how proposed activities improve or maintain these conditions for steelhead or coho salmon move within the natural variability needed to support these species

- Description of key habitat elements (*i.e.*, temperature; habitat type: pool, riffle, flatwater; estimate of instream shelter and shelter components; water depth; dominant substrate type, etc.) for coho salmon and steelhead in project area
- Pre and post (after winter flow event) information on the elevation of the inlet and outlet structure relative to the 2-year flood
- A description of if and when the off channel feature became disconnected from the main channel and at what flow level (cfs). This will require checking the project site daily when the off channel feature is becoming disconnected from the main channel
- A description of any stranded fish observed. If there are salmonids stranded, the applicant will contact NMFS PRD immediately to determine if a fish rescue action is necessary. CDFG (Gayle Garman (707) 445-6512 or Watershed Biologist Michelle Gilroy (707) 445-6493) will also be contacted with fish rescue information and/or mortalities by species

3. <u>Annual Report</u>

Annually, the TEAM will prepare a report summarizing results of projects implemented under the Program during the most recent construction season and results of post-construction implementation and effectiveness monitoring for that year and previous years. The annual report shall include a summary of the specific type and location of each project, stratified by individual project, 4th field HUC and ESU and/or DPS. The report shall include the following project-specific information:

- A summary detailing fish relocation activities, including the number and species of fish relocated and the number and species injured or killed.
- A map indicating the location of each project
- The number and type of instream structures implemented within the stream channel.
- The size (acres, length, and depth) of off channel habitat features enhanced or created.
- The length of streambank (feet) stabilized or planted with riparian species.
- The number of culverts replaced or repaired, including the number of miles of restored access to unoccupied salmonid habitat.
- The size on number of dams removed, including the number of miles of restored access to unoccupied salmonid habitat.
- The distance (feet) of aquatic habitat disturbed at each project site.

III. ANALYTICAL APPROACH

Pursuant to section 7(a)(2) of the Endangered Species Act (ESA), Federal agencies are directed to insure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. This section contains the conceptual framework and key steps and assumptions utilized in the jeopardy analysis, followed by the framework proposed for the analysis of destruction or adverse modification of critical habitat.

A. Legal and Policy Framework

Section 7(a)(2) of the ESA and its implementing regulations (50 CFR Part 402), and associated guidance documents (*e.g.*, Endangered Species Consultation Handbook 1998) require biological opinions to present: (1) a description of the proposed federal action, (2) a summary of the status of the affected listed species and designated critical habitat, (3) a summary of the environmental baseline within the action area, (4) a detailed analysis of the effects of the Proposed Action on the affected species and critical habitat, (5) a description of cumulative effects (future non-federal actions that are reasonably certain to occur), and (6) a conclusion as to whether the Proposed Action is likely to jeopardize the continued existence of the listed species or likely to result in the destruction or adverse modification of the designated critical habitat of the listed species. By regulation (50 CFR § 402.02), the "effects of the action" include the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that will be added to the environmental baseline. To evaluate whether an action is likely to result in jeopardy to a listed species or result in the destruction or adverse modification of designated critical habitat, consideration is given to the combination of the status of the species and critical habitat, the effects of the action, and the cumulative effects of reasonably certain to occur non-federal actions. An action that is likely to *jeopardize the continued existence* of the listed species is one that is likely to appreciably reduce the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution (50 CFR § 402.02). In this opinion, NMFS makes this evaluation of extinction risk and its relationship to the legal standard "likelihood of both survival and recovery" and the best available scientific information relating to viable salmonid populations (McElhany et al. 2000) as described in the *Ecological Conceptual Framework* below.

B. Ecological Conceptual Framework

We used a conceptual model of the species to evaluate the effects of the Project. For this consultation, the conceptual model is structured and described around listed SONCC coho salmon (although the model is also applicable to and used for Chinook salmon and steelhead in the action area of the Program). In this consultation the conceptual model is based on a hierarchical organization of individual fish, population unit, and evolutionarily significant unit (ESU). The guiding principle behind this conceptual model is that the likelihood of survival and recovery of a species is dependent on the likelihood of survival and recovery of populations in the species (organized by diversity strata[2] that comprise that species), and the likelihood of survival and recovery of each population unit is dependent upon the fitness (lifetime reproductive

2 Diversity strata are defined as groups of populations that span the diversity of environments and distribution that currently exists or historically existed within the ESU.

success) of the individuals that comprise that population.

A prerequisite for predicting the effects of a proposed action on a population/species includes an understanding of the condition of the population/species in terms of their probability of surviving and recovering. To do this, we assessed their chances of recovery given their condition and threat regime during the period of project effects. Viability is defined as "the state in which extinction risk of a population is negligible over 100 years and full evolutionary potential is retained" (McElhany et al. 2000). A viable population (or species) is one that has achieved the demographic parameters needed to be at low risk of extinction. Importantly, a viable population (or species) is not necessarily one that has recovered as defined under the ESA. To meet recovery standards, the species may need to achieve higher levels of resiliency to allow for activities such as commercial harvest and the existing threat regime would need to be abated or ameliorated as detailed in a recovery plan. As a result, we evaluate the current status of the species to diagnose how near, or far, the species is from this viable state because it is an important metric indicative of a self-sustaining species in the wild, but we also consider the ability of the species to recover in light of its current condition and the status of the existing and future threat regime. Generally, NMFS folds this consideration of current condition and ability to recover into a conclusion regarding the "risk of extinction" of the populations or species. We equated the risk of extinction of the species with the "likelihood of both the survival and recovery of the species in the wild" for purposes of conducting jeopardy analyses under section 7(a)(2) of the ESA. Our jeopardy assessment, therefore, focused on whether a proposed action appreciably increased extinction risk, which is a surrogate for appreciable reductions in the likelihood of both the survival and recovery of the species in the wild.

We adopted the general life cycle approach outlined by McElhany et al. (2000) and used the Viable Salmonid Populations (VSP) concept as an organizing framework in this consultation. We used the VSP concept to systematically examine the complex linkages of project effects on viability while also addressing key risk factors such as climate change and ocean condition. The four VSP parameters (abundance, population growth rate [productivity], population spatial structure, and population diversity) reflect general biological and ecological processes that are critical to the growth and survival of coho salmon and are used to evaluate the risk of extinction of the SONCC coho salmon ESU (McElhany et al. 2000). The first three parameters are consistent with and are used as surrogates for the "reproduction, numbers, or distribution" criteria found within the regulatory definition (50 CFR § 402.02) of *jeopardize the continued existence…* (*i.e.*, jeopardy). The fourth VSP parameter, diversity, relates to all three jeopardy criteria. For example, 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.

C. Risk Assessments

As described above, the regulations implementing section 7(a)(2) of the ESA direct us to assess proposed project effects on the ESU in order to determine whether the proposed project is likely to jeopardize the listed species. Generally, we first identified the environmental "stressors" (physical, chemical or biotic) directly or indirectly caused by the Project to which coho salmon are expected to be exposed to, the nature of the exposure, and the life stages that would be exposed. Next, we evaluated the likely response of coho salmon to such stressors based on the best scientific and commercial information available, including observations of how past similar exposures has affected the species. We then examined the effects of hydrological modifications to individuals of the species given the physical, chemical, or biotic needs of coho salmon in the action area. We assessed whether the conditions that result from the Project, in combination with conditions influenced by other past and ongoing activities and natural phenomena as described in the Environmental Baseline, will affect the growth, survival, or reproductive success of individual coho salmon.

D. Jeopardy Assessment Approach

Our jeopardy assessment begins with a diagnosis of the current status of the SONCC coho salmon ESU throughout its geographic range. In other words, NMFS evaluates the current risk of extinction of the SONCC coho salmon ESU given its exposure to human activities and natural phenomena throughout its geographic distribution. As discussed above, NMFS utilizes the VSP conceptual framework for this assessment. The diagnosis describes the species status, identifies existing threats, and details the distribution and trends of threats throughout the range of the SONCC coho salmon ESU. We describe the status of the species at the ESU or DPS scales in terms of the VSP parameter and the diversity strata within the ESU that are expected to be affected by the Project. In addition, we consider the effects of climate change and the influence of ocean condition on the species. Because NMFS' opinion as to whether an action is likely to jeopardize a species is based on the species-as-listed scale (ESU for coho salmon), the SONCC coho salmon diagnosis presented in the *Status of the Species* section of this opinion provides a point-of-reference that NMFS uses in its final steps in the jeopardy analysis within the *Integration and Synthesis* section.

Our jeopardy risk assessment continues with the Environmental Baseline, which is designed to assess the current risk of extinction of coho salmon population units at the scale of the action area given their exposure to human activities and natural phenomena. As specified under section 7 regulations, the environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The Environmental Baseline of this Opinion identifies the antecedent conditions, including those that likely have resulted from past projects, on individual coho salmon and the viability parameters of coho salmon populations at the action area scale. Because our jeopardy analysis must consider the effects of the Project within the context of the other impacts experienced by the species, some information provided in the Environmental

Baseline is also used to describe the conditions faced by the same individuals that will be affected by the Project. NMFS uses the analysis of how activities other than Project activities have impacted the fitness of individual coho salmon to provide the context or condition of the animals that the proposed Project will impact from now until 2015.

In the *Effects of the Action* section, NMFS evaluates the likely effects of the Project to coho salmon within the action area. We use the stressor, exposure, and response framework described above to identify the probable risks that individual coho salmon will likely experience as a result of the Project.

Once the fitness of individual coho salmon is determined, the next steps in NMFS' jeopardy assessment are to evaluate whether these fitness consequences are reasonably likely to result in changes in the risk of extinction of coho salmon populations in the action area. We complete this assessment by relying on the information available about the species and the specific population units in terms of current and needed levels of abundance, productivity, diversity, and spatial structure characteristics, as presented in the *Status of the Species* and *Environmental Baseline* sections. For example, lower survival resulting from loss or reduction of rearing habitat may reduce abundance. This same reduction can reduce the productive capacity of the river system and impact the productivity of the population, or constrain the ability of individuals of the species to track environmental changes, affecting the diversity and spatial structure of the population. If a population unit is at high risk of extinction due to the current condition of one or more of these characteristics, negative impacts to those same vulnerable characteristics are more likely to increase appreciably the risk of extinction of a population unit. Impacts to less vulnerable characteristics or to a population unit facing a low risk of extinction (generally, a higher likelihood of being at or near a viable state) are less likely to increase the population's risk of extinction.

NMFS may conclude that an action is likely to jeopardize the species through one or more of at least two mechanisms: (1) increases in the risk of extinction of the species or (2) decreases in the chance that the species can become viable or recovered. Increases in the extinction risk of the species are considered appreciable reductions in the likelihood of both survival and recovery of the species. Conversely, if no increases in a population unit's risk of extinction are expected, we could conclude that the ESU is not appreciably affected by the Project.

In our jeopardy risk assessment for the species, we relied on Williams et al. (2008) for demographic viability criteria. The viability objective at the ESU level is that all diversity strata be viable. Ultimately, the viability of the ESU depends on the extinction risk of its constituent populations. As stated in Williams et al. (2008) "the ability of populations to function in an integrated manner and persist across the landscape creates the foundation of ESU viability." This integration is based on connectivity among populations (through dispersal) and a diverse set of habitats that allow for the expression of various life history types (Williams and Reeves 2003). By requiring all diversity strata be viable, there is a greater chance that the range of historical environmental conditions will be represented and therefore, a greater chance that the range of historical diversity within the ESU will be represented. Viable strata also helps ensure that an ESU persists throughout most of its historical range, and that there is connectivity across the ESU.

E. Destruction or Adverse Modification Determination

This biological opinion does not rely on the regulatory definition of destruction or adverse modification of critical habitat at 50 CFR 402.02[3]. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat. The basis of the "destruction or adverse modification" analysis is to evaluate whether the proposed action results in negative changes in the function and value of the critical habitat in the conservation of the species. Therefore, NMFS bases the critical habitat analysis on the affected areas and functions of critical habitat essential for the conservation of the species (not on how individuals of the species will respond to changes in habitat quantity and quality).

For purposes of the destruction or adverse modification determination, we add the effects of the proposed Federal action on designated critical habitat in the action area, and any cumulative effects, to the environmental baseline and then determine if the resulting changes to the conservation value of critical habitat in the action area are likely to cause an appreciable reduction in the conservation value of critical habitat ESU/DPS-wide. Similar to the hierarchical approach used above, if the proposed action will negatively affect the primary constituent elements (PCEs) of critical habitat in the action area we then assess whether the conservation value of the stream reach or river, larger watershed areas, and whole watersheds will be reduced. If these larger geographic areas are likely to have their critical habitat value reduced, we then assess whether or not this reduction will impact the conservation value of the DPS or ESU critical habitat designation as a whole.

F. Use of Best Available Scientific and Commercial Information

To conduct the assessment, NMFS examined an extensive amount of information from a variety of sources. Detailed background information on the biology and status of the listed species and critical habitat has been published in a number of documents including peer reviewed scientific journals, primary reference materials, and governmental and non-governmental reports. Additional information regarding the effects of the proposed action on the listed species and the environmental consequences of the actions as a whole was formulated from the aforementioned resources, the years of monitoring reports for the Grant Program, and applicable project meeting notes. A complete copy of the administrative record is kept at the NOAA, NMFS, SWR Northern California Office, in Arcata, California.

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3 This regulatory definition was invalidated by Federal Courts (*Gifford Pinchot Task Force* v. *U.S. Fish and Wildlife*, 378 F.3d 1059 [9th Cir. 2004] and *Sierra Club* v. *U.S. Fish and Wildlife Service*, 245 F.3d 434 [5th Cir. 2001]).

IV. STATUS OF THE SPECIES

This biological opinion analyzes the effects of the proposed action on the following listed species and their designated critical habitats:

Southern DPS of Pacific Eulachon
(*Thaleichthys pacificus*)
Threatened (75 FR 13012, March 18, 2010)

Southern Resident Killer Whales DPS
(*Orcinus orca*)
Endangered (70 FR 69903, November 18, 2005)

Southern DPS of North American Green Sturgeon
(*Acipenser medirostris*)
Threatened (71 FR 17757, April 7, 2006)
Designated critical habitat (74 FR 52300, October 9, 2009)

Threatened SONCC coho salmon (*Oncorhynchus kisutch*)
Listing determination (70 FR 37160; June 28, 2005)
Critical habitat designation (64 FR 24049; May 5, 1999)

Threatened CC Chinook salmon (*O. tshawytscha*)
Listing determination (70 FR 37160; June 28, 2005)
Critical habitat designation (70 FR 52488; September 2, 2005)

Threatened NC steelhead (*O. mykiss*)
Listing determination (71 FR 834; January 5, 2006)
Critical habitat designation (70 FR 52488; September 2, 2005)

As mentioned earlier in this opinion, NMFS concluded that the project, as proposed, is not likely to adversely affect southern DPS of Pacific Eulachon, southern DPS of Green Sturgeon, or Southern Resident Killer Whales; or designated critical habitat for Southern eulachon, or Southern Green Sturgeon. These species or their critical habitat will not be discussed further in this biological opinion.

In this opinion, NMFS assesses the status of SONCC coho salmon, CC Chinook salmon, and NC steelhead by examining four types of information, all of which help us understand a population's ability to survive and recover. These population viability parameters are abundance, population growth rate, spatial structure, and diversity (McElhany et al. 2000). While there is insufficient information to evaluate these population viability parameters in a quantitatively, NMFS has used existing information to determine the general condition of each population and factors responsible for the current status of each ESU.

Table 2 summarizes the *Federal Register* (FR) Notice dates and citations, and geographic distributions for these species and critical habitats. This section of the Opinion updates the status of critical habitat, and population trends at the ESU or DPS scale. Updated information on abundance and distribution, along with an updated description of designated critical habitat in the action area, is provided in the *Environmental Baseline* section of this Opinion.

Table 2. The scientific name, listing status under the ESA, FR notice citation, and geographic distribution of the ESUs and DPS addressed in this Assessment.

	SONCC Coho Salmon ESU	NC Steelhead DPS	CC Chinook Salmon ESU
Scientific Name	*Oncorhynchus* (*O.*) *kisutch*	*O. mykiss*	*O. tshawytscha*
Listing Status	Threatened	Threatened	Threatened
Federal Register Notice	6/28/2005 (70 FR 37160)	ESU listed on June 7, 2000 (65 FR 36074) Relisted as a DPS on January 5, 2006 (71 FR 834)	6/28/2005 (70 FR 37160)
Geographic Distribution	From Cape Blanco, Oregon, to Punta Gorda, California	From Redwood Creek (Humboldt County), southward to, but not including, the Russian River	From Redwood Creek (Humboldt County) south to, and including, the Russian River
Critical Habitat Designation	5/5/1999 (64 FR 24049)	9/2/2005 (70 FR 52488)	9/2/2005 (70 FR 52488)

A. Species Life History, Distribution, and Abundance

Life history diversity of federally listed species substantially contributes to their persistence, and conservation of such diversity is a critical element of recovery efforts (Beechie et al. 2006). Waples et al. (2001) and Beechie et al. (2006) found that life history and genetic diversity of Pacific salmon and steelhead (*Oncorhynchus* spp.) show a strong, positive correlation with the extent of ecological diversity experienced by a species.

1. NC Steelhead

a. Life History

Steelhead have the most diverse range of any salmonid life history strategies (Quinn 2005). There are two basic steelhead life history patterns, winter-run and summer-run (Quinn 2005, Moyle 2002). Winter-run steelhead enter rivers and streams from December to March in a sexually mature state and spawn in tributaries of mainstem rivers, often ascending long distances (Moyle 2002). Summer steelhead (also known as spring-run steelhead) enter rivers in a sexually immature state during receding flows in spring, and migrate to headwater reaches of tributary streams where they hold in deep pools until spawning the following winter or spring (Moyle 2002). Spawning for all runs generally takes place in the late winter or early spring. Eggs hatch in 3 to 4 weeks and fry emerge from the gravel 2 to 3 weeks later (Moyle 2002). Juveniles spend 1 to 4 years in freshwater before migrating to estuaries and the ocean where they spend 1 to 3 years before returning to freshwater to spawn. Another life history diversity of steelhead is the "half pounder." "Half pounder" steelhead are sexually immature steelhead that spend about 3 months in estuaries or the ocean before returning to lower river reaches on a feeding run (Moyle 2002). Half pounders then return to the ocean where they spend 1 to 3 years before returning to freshwater to spawn. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby et al. 1996). However, it is rare for steelhead to spawn more than twice before dying, and most that do so are females (Busby et al. 1996). Some steelhead "residualize," becoming resident trout and never adopting the anadromous life history.

b. Current Distribution and Abundance

The NC steelhead DPS includes all naturally spawning populations of steelhead in California coastal river basins from Redwood Creek, Humboldt County, to just south of the Gualala River, Mendocino County (Spence et al. 2008). This distribution includes the Eel River, the third largest watershed in California, with its four forks (North, Middle, South, and Van Duzen) and their extensive tributaries. Spence et al. (2008) identified 42 historically independent populations in the DPS based on habitat availability and gene flow among watersheds. An additional 33 small populations are likely dependent upon immigration from the more permanent populations (Bjorkstedt et al. 2005). With few exceptions, NC steelhead are present wherever streams are accessible to anadromous fishes and have sufficient flows. Big and Stone lagoons, between Redwood Creek and Little River, contain steelhead following their opening to the ocean in the early winter, although the source of these fish is unknown (Sparkman 2007, Moyle et al. 2008).

There is a notable lack of quantitative information on NC steelhead, but there are a few survey index estimates of stock trends. Most data come from fish counts from the 1930s and 1940s at three dams: Sweasey Dam on the Mad River (annual adult average 3,800 in the 1940s), Cape Horn Dam on the upper Eel River (4,400 annual average in the 1930s), and Benbow Dam on the South Fork Eel River (18,784 annual average in the 1940s; Murphy and Shapovalov 1951, Shapovalov and Taft 1954, Busby et al. 1996). These data can be compared to the annual average of 2,000 at Sweasey Dam in the 1960s, annual average at 1,000 at Cape Horn Dam in the 1980s, and annual average of 3,355 at Benbow Dam in the 1970s (McEwan and Jackson 1996, Busby et al. 1996). In the mid-1960s, California Department of Fish and Game (CDFG) estimated steelhead spawning in many rivers in this ESU to total about 198,000 (McEwan and Jackson 1996).

Currently, the most abundant run is in the Middle Fork Eel River, with about 2,000 fish in 1996 (McEwan and Jackson 1996). Substantial declines from historic levels at major dams indicate a probable decline from historic levels at the DPS scale. Adams (2000) concluded that the status of the population had changed little since the 1996 status review. Based on the declining abundance and the inadequate implementation of conservation measures, NMFS concluded that the NC steelhead ESU warranted listing as a threatened species (65 FR 36074, June 7, 2000).

Steelhead abundance estimates are summarized in the most recent NMFS west coast steelhead status reviews (Good et al. 2005). The Biological Review Team (BRT) made the following conclusions, albeit with limited data, that: (1) population abundances are low, compared to historical estimates; (2) recent trends are downward (except for a few small summer-run stocks), and (3) summer-run steelhead abundance was “very low” (Good et al. 2005). Lack of data on run sizes within the DPS was a major source of uncertainty in the BRT’s assessment.

2. <u>CC Chinook Salmon</u>

a. Life History

Adult Chinook salmon reach sexual maturity usually at 3 to 5 years, and die soon after spawning. Precocious 2 year olds, especially male jacks, make up a relatively small percentage of the spawning population. Healey (1991) describes two basic life history strategies for Chinook salmon, stream-type and ocean-type, within which there is a strategy that provides variation within the species. Like most salmonids, Chinook salmon have evolved with variation in juvenile and adult behavioral patterns, which can help decrease the risk of catastrophically high mortality in a particular year or habitat (Healey 1991). Spring-run Chinook salmon are often stream-type (Healey 1991, Moyle 2002). Adults return to lower-order headwater streams in the spring or early summer before they reach sexual maturity, and hold in deep pools and coldwater areas until they spawn in early fall (Healey 1991, Moyle 2002). This strategy has been allowing spring-run Chinook salmon to take advantage of mid-elevation habitats inaccessible during the summer and fall due to low flows and high water temperatures (Moyle 2002). Juveniles emerge from the gravel in the early spring and typically spend one year in freshwater before migrating downstream to estuaries and then the ocean (Moyle 2002). A CDFG outmigrant trapping program on the Mad River found a small proportion of Chinook juveniles oversummer in freshwater (Sparkman 2002).

Fall-run Chinook salmon are unambiguously ocean-type (Moyle 2002); specifically adapted for spawning in lowland reaches of big rivers and their tributaries (Moyle 2002, Quinn 2005).

Adults move into rivers and streams from the ocean in the fall or early winter in a sexually mature state and spawn within a few weeks or days upon arrival on the spawning grounds (Moyle 2002). Juveniles emerge from the gravel in late winter or early spring and within a matter of months, migrate downstream to the estuary and the ocean (Moyle 2002, Quinn 2005). This life history strategy allows fall-run Chinook salmon to utilize quality spawning and rearing areas in the valley reaches of rivers, which are often too warm to support juvenile salmonid rearing in the summer (Moyle 2002).

b. Current Distribution and Abundance

Only fall-run Chinook salmon currently occur in the CC Chinook salmon ESU. Spring-run stocks no longer occur in the North-Central California Coast Recovery Domain which includes the region between Redwood Creek in Humboldt County and Aptos Creek in Santa Cruz County. However, information indicates that spring-run Chinook salmon existed in the Mad River and the North Fork and Middle Fork of the Eel River (Keter 1995, Myers et al. 1998, Moyle 2002).

CC Chinook salmon are distributed at the southern end of the species' North American range; only Central Valley fall-run Chinook salmon are found spawning farther south. NMFS identified four regions of this portion of the California coast with similar basin-scale environmental and ecological characteristics (Bjorkstedt et al. 2005). In these four regions, 16 watersheds were identified that have a minimum amount of habitat available to support independently viable populations. In the *North Mountain-Interior Region*, the Upper Eel and Middle Fork Eel rivers contain functionally independent CC Chinook salmon stocks, while the Lower Eel and Van Duzen rivers have the potential to be independent. Chinook salmon are observed annually in the Middle Fork Eel River, in Black Butte River, and near Williams Creek. Chinook salmon are also observed annually in the Outlet Creek drainage and in the smaller tributaries feeding Little Lake Valley (Harris 2009). In the *North Coastal Region*, Redwood Creek and the Mad, Lower Eel, South Fork Eel, Bear and Mattole rivers all contain sufficient habitat for functionally independent CC Chinook salmon populations. NMFS also identified Little River and Humboldt Bay tributaries as containing potentially independent populations. All of these independent populations in the North Coastal Region still contain extant populations, but at much reduced abundance and distribution than historically. In the *North-Central Coastal Region*, numerous watersheds in Mendocino County contain small runs of CC Chinook salmon that are dependent on self-sustaining stocks in Ten Mile, Noyo, and Big rivers. Along the *Central Coastal Region*, the Navarro, Garcia and Gualala rivers historically had independent populations but apparently no longer do (Moyle et al. 2008). Additionally, the Russian River appears to support a Chinook salmon population, although the role of hatcheries and straying from the Eel River (by fish attracted to Eel River water that has been diverted into the Russian River) is uncertain. Seventeen additional watersheds were identified by NMFS to contain CC Chinook salmon, but due to limited habitat were believed not to support persisting populations (Good et al. 2005). While Chinook salmon are also encountered in the San Francisco Bay region, these fish most likely originated from Central Valley populations and are not included in the ESU (Moyle et al. 2008).

Available information on the historical abundance of CC Chinook salmon are summarized in Myers et al. (1998). The following are excerpts from this document:

> Estimated escapement of this ESU was estimated at 73,000 fish, predominantly in the Eel River (55,500) with smaller populations in Redwood Creek, Mad River, Mattole River (5,000 each), Russian River (500), and several small streams in Del Norte and Humboldt Counties.

Observed widespread declines in abundance and the present distribution of small populations with sometimes sporadic occurrences contribute to the risks faced in this ESU. Concerns about current abundances relative to historical abundances, mixed trends in the few time series available, and potential extirpations in the southern part of the range contributed to the conclusion that CC Chinook salmon are "likely to become endangered" in the foreseeable future throughout all or a significant portion of their range (70 FR 37160, Good et al. 2005).

Good et al. (2005) found that historical and current information indicate that CC Chinook salmon populations have declined. Low abundance, introduction of hatchery fish, and reduced distribution continues to substantially contribute to risks facing this ESU.

3. SONCC Coho Salmon

a. Life History

Adult coho salmon reach sexual maturity at 3 years, and die after spawning. Precocious 2 year olds, especially males, also make up a small percentage of the spawning population. Coho salmon adults migrate and spawn in small streams that flow directly into the ocean, or tributaries and headwater creeks of larger rivers (Sandercock 1991, Moyle 2002). Adults migrate upstream to spawning grounds from September through late December, peaking in October and November. Spawning occurs mainly in November and December, with fry emerging from the gravel in the spring, approximately 3 to 4 months after spawning. Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although they may move up to streams of 4 percent or 5 percent gradient. Juveniles have been found in streams as small as 1 to 2 meters wide. They may spend 1 to 2 years rearing in freshwater (Bell and Duffy 2007), or emigrate to an estuary shortly after emerging from spawning gravels (Tschaplinski 1988). Coho salmon juveniles are also known to "redistribute" into non-natal rearing streams, lakes, or ponds, often following rainstorms, where they continue to rear (Peterson 1982). At a length of 38 to 45 mm, fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Godfrey 1965, Sandercock 1991, Nickelson et al. 1992). Emigration from streams to the estuary and ocean generally takes place from March through May.

b. Current Distribution and Abundance

Reliable current time series of naturally produced adult migrants or spawners are not available for SONCC coho salmon ESU rivers (Good et al. 2005). For a summary of historical and current distributions of SONCC coho salmon in northern California, refer to CDFG's (2002) coho salmon status review, historical population structure by Williams et al. (2006), as well as the presence and absence update for the northern California portion of the SONCC coho salmon ESU (Brownell et al. 1999). Good et al. (2005) concluded that SONCC coho salmon were likely to become endangered in the foreseeable future, which is consistent with an earlier assessment (Weitkamp et al. 1995). Although there are few data, the information that is available for SONCC coho salmon indicates the component populations are in decline and strongly suggests the ESU is at risk (Weitkamp et al. 1995, CDFG 2002, Good et al. 2005). NMFS (2001) concluded that population trend data for SONCC coho salmon from 1989 to 2000 show a continued downward trend throughout most of the California portion of the SONCC coho salmon ESU.

The main stocks in the SONCC coho salmon ESU (Rogue, Klamath, and Trinity Rivers) remain heavily influenced by hatcheries and have little natural production in mainstem rivers (Weitkamp et al. 1995, Good et al. 2005). The listing of SONCC coho salmon includes all hatchery-produced coho salmon in the ESU range (70 FR 37160, June 28, 2005). Trinity River Hatchery maintains high production, with a significant number of hatchery SONCC coho salmon straying into the wild population (NMFS 2001). The Mad River Hatchery ceased coho salmon production in 1999. Iron Gate Hatchery has had a production goal of 75,000 juvenile coho since 1966. This production goal had been substantially exceeded until 1994 when the hatchery reduced production to be more consistent with their production goals. The apparent decline in wild production in these rivers, in conjunction with significant hatchery production, suggests that natural populations of coho salmon are not self-sustaining (Weitkamp et al. 1995, Good et al. 2005). Coho salmon populations continue to be depressed relative to historical numbers, and there are strong indications that breeding groups have been lost from a significant percentage of streams within their historical range (Good et al. 2005).

Brown et al. (1994) estimated that the rivers and tributaries in the California portion of the SONCC coho salmon ESU produced an average of 7,080 naturally spawning coho salmon and 17,156 hatchery returns, including 4,480 "native" fish occurring in tributaries having little history of supplementation with nonnative fish. Combining the California run-size estimates with Rogue River estimates, Weitkamp et al. (1995) arrived at a rough minimum run-size estimate for the SONCC coho salmon ESU of about 10,000 natural fish and 20,000 hatchery fish.

Brown and Moyle (1991) suggested that naturally-spawned adult coho salmon runs in California streams were less than one percent of their abundance at mid-century, and estimated that wild coho salmon populations in California did not exceed 100 to 1,300 individuals. CDFG (1994) summarized most information for the northern California portion of this ESU, and concluded that "coho salmon in California, including hatchery stocks, could be less than 6 percent of their abundance during the 1940s, and have experienced at least a 70 percent decline in numbers since the 1960's." Further, CDFG (1994) reported that coho salmon populations have been virtually eliminated in many streams, and that adults are observed only every third year in some streams, suggesting that two of three brood cycles may have already been eliminated.

Scientists at the NMFS Southwest Fisheries Science Center compiled a presence-absence database for the SONCC coho salmon ESU similar to that developed by CDFG (Good et al. 2005). The data set includes information for coho salmon streams listed in Brown and Moyle (1991), as well as other streams that NMFS found historical or recent evidence of coho salmon presence. The database is a composite of information contained in the NMFS (2001) status review update, additional information gathered by NMFS since publication of the 2001 status review, data used in the CDFG (2002) analysis, and additional data compiled by CDFG (Jong 2002) for streams not on the Brown and Moyle (1991) list. Using the NMFS database, Good et al. (2005) compiled information on the presence of coho salmon in streams throughout the SONCC ESU (figure 2), which closely matched the results of Brown and Moyle (1991).

Annually, the estimated percentage of streams in the SONCC coho salmon ESU for which coho salmon presence was detected generally fluctuated between 36 percent and 61 percent between brood years 1986 and 2000 (figure 2). Data reported for the 2001 brood year suggest a strong year class, as indicated by an occupancy rate of more than 75 percent; however, the number of streams for which data were reported is small compared to previous years. The data suggest that, for the period of record, occupancy rates in the SONCC coho salmon ESU were highest (54 to 61 percent) between brood years 1991 and 1997, then declined between 1998 and 2000 (39 to 51 percent) before rebounding in 2001. However, the number of streams surveyed in 2001 was roughly 25 percent of the number surveyed in previous years (Good et al. 2005). For a discussion of the current viability of the SONCC coho salmon ESU, please see the *Viability of the ESU/DPS* section of this document.

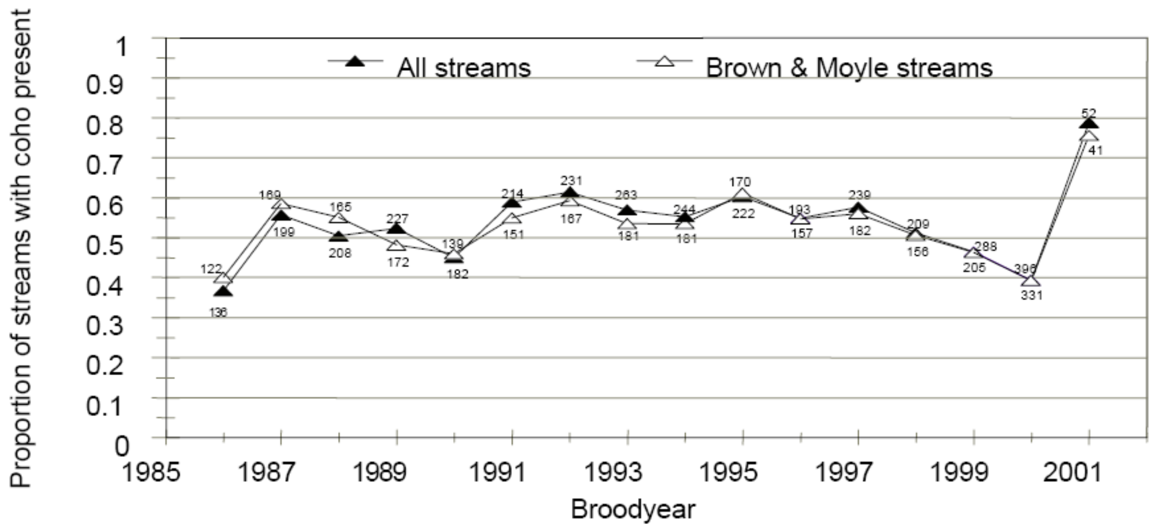

Figure 2. Proportion of surveyed streams where coho salmon were detected (Good et al. 2005). The number of streams surveyed are identified next to data.

B. Factors Responsible for Salmonid Decline (ESU or DPS Scale)

The factors that have caused declines in the SONCC coho salmon ESU, CC Chinook salmon ESU, and NC steelhead DPS are similar. These factors include habitat loss due to dam building, degradation of freshwater habitats due to a variety of agricultural and forestry practices, water diversions, urbanization, mining, and severe recent flood events, which are exacerbated by land use practices (Good et al. 2005). Sedimentation and loss of spawning gravels associated with poor forestry practices and road building are particularly acute problems that can reduce the productivity of salmonid populations. Nonnative Sacramento pikeminnow (*Ptychocheilus grandis*) occupy the Eel River basin and prey on juvenile salmonids (Good et al. 2005) and compete for the same resources. Droughts and unfavorable ocean conditions in the late 1980s and early 1990s were identified as further likely causes of decline (Good et al. 2005).

1. Timber Harvest

Timber harvest and associated activities occur over a large portion of the range of the affected species. Timber harvest has caused widespread increases in sediment delivery to channels through both increased landsliding and surface erosion from harvest units and log decks. Much of the riparian vegetation has been removed, reducing future sources of LWD needed to form and maintain stream habitat that salmonids depend on during various life stages.

In the smaller Class II and III streams, recruited wood usually cannot be washed away, so logs remain in place and act as check-dams that store sediment eroded from hillsides (Reid 1998). Sediment storage in smaller streams can persist for decades (Nakamura and Swanson 1993). In assessing the characteristics of Class III watercourses including within the Mad River watershed, Simpson Resource Company (2002) found that coniferous woody debris was the predominant channel bed grade control. Furthermore, where channels are prone to sediment debris flows, woody debris and adjacent riparian stands can provide roughness that limit the distance debris flows may travel down into channels (Ketcheson and Froehlich 1978, Pacific Watershed Associates (PWA) 1998). For example, in Bear Creek, a tributary to the Eel River, PWA (1998) noted that debris flows now travel farther downstream and channel aggradation extends farther downstream because of inadequate large wood from landslide source areas and streamside vegetation.

On larger channels, wood again stores sediment, and provides a critical element in the habitat of aquatic life forms (Spence et al. 1996, Reid 1998). Sullivan et al. (1987) found that woody debris forms abundant storage sites for sediment in forest streams as large as fourth-order (20 to 50 km^2 drainage area), where storage is otherwise limited by steep gradients and confinement of channels between valley walls. Studies of this storage function in Idaho by Megahan and Nowlin (1976) and in Oregon by Swanson and Lienkamper (1978) indicated that annual sediment yields from small forested watersheds are commonly less than 10 percent of the sediment stored in channels.

In fish-bearing streams, woody debris is important for storing sediment, halting debris flows, and decreasing downstream flood peaks, and its role as a habitat element becomes directly relevant for Pacific salmon species (Reid 1998). LWD alters the longitudinal profile and reduces the local gradient of the channel, especially when log dams create slack pools above or plunge pools below them, or when they are sites of sediment accumulation (Swanston 1991).

Cumulatively, the increased sediment delivery and reduced woody debris supply have led to widespread impacts to stream habitats and salmonids. These impacts include reduced spawning habitat quality, loss of pool habitat for adult holding and juvenile rearing, loss of velocity refugia, and increases in the levels and duration of turbidity which reduce the ability of juvenile fish to feed and, in some cases, may cause physical harm by abrading the gills of individual fish. These changes in habitat have led to widespread decreases in the carrying capacity of streams that support salmonids.

2. Road Construction

Road construction, whether associated with timber harvest or other activities, has caused widespread impacts to salmonids (Furniss et al. 1991). Where roads cross salmonid-bearing streams, improperly placed culverts have blocked access to many stream reaches. Land sliding and chronic surface erosion from road surfaces are large sources of sediment across the affected species' ranges. Roads also have the potential to increase peak flows and reduce summer base flows with consequent effects on the stability of stream substrates and banks. Roads have led to widespread impacts on salmonids by increasing the sediment loads. The consequent impacts on habitat include reductions in spawning, rearing and holding habitat, and increases in turbidity.

The delivery of sediment to streams can be generally considered as either chronically delivered, or more episodic in nature. Chronic delivery refers to surface erosion that occurs from rain splash and overland flow. More episodic delivery, on the order of every few years, occurs in the form of mass wasting events, or landslides, that deliver large volumes of sediment during large storm events.

Road construction, use, and maintenance, tree-felling, log hauling, slash disposal, site preparation for replanting, and soil compaction by logging equipment are all potential sources of fine sediment that could ultimately deliver to streams (Hicks et al. 1991, Murphy 1995). The potential for delivering sediment to streams increases as hillslope gradients increase (Murphy 1995). The soils in virgin forests generally resist surface erosion because their coarse texture and thick layer of organic material and moss prevent overland flow (Murphy 1995). Activities associated with timber management decrease the ability of forest soils to resist erosion and contribute to fine sediment in the stream. Yarding activities that cause extensive soil disturbance and compaction can increase splash erosion and channelize overland flow. Site preparation and other actions which result in the loss of the protective humic layer can increase the potential for surface erosion (Hicks et al. 1991). Controlled fires can also consume downed wood that had been acting as sediment dams on hillslopes. After harvesting, root strength declines, often leading to slumps, landslides, and surface erosion (FEMAT 1993, Thomas et al. 1993). Riparian tree roots provide bank stability and streambank sloughing. Erosion often increases if these trees are removed, leading to increases in sediment and loss of overhanging banks, which are important habitat for rearing Pacific salmonids (Murphy 1995). Where rates of timber harvest are high, the effects of individual harvest units on watercourses are cumulative. Therefore, in sub-watersheds where timber harvest is concentrated in a relatively short timeframe, we expect that fine sediment impacts will be similarly concentrated.

Construction of road networks can also greatly accelerate erosion rates within a watershed (Haupt 1959, Swanson and Dyrness 1975, Swanston and Swanson 1976, Reid and Dunne 1984, Hagans and Weaver 1987). Once constructed, existing road networks are a chronic source of sediment to streams (Swanston 1991) and are generally considered the main cause of accelerated surface erosion in forests across the western United States (Harr and Nichols 1993). Processes initiated or affected by roads include landslides, surface erosion, secondary surface erosion (landslide scars exposed to rainsplash), and gullying. Roads and related ditch networks are often connected to streams via surface flow paths, providing a direct conduit for sediment. Where roads and ditches are maintained periodically by blading, the amount of sediment delivered continuously to streams may temporarily increase as bare soil is exposed and ditch roughness features which store and route sediment and also armor the ditch are removed. Hagans and Weaver (1987) found that fluvial hillslope erosion associated with roads in the lower portions of the Redwood Creek watershed produced about as much sediment as landslide erosion between 1954 and 1980. In the Mattole River watershed, which is south of the project area, the Mattole Salmon Group (1997) found that roads, including logging haul roads and skid trails, were the source of 76% of all erosion problems mapped in the watershed. This does suggest that, overall, roads are a primary source of sediment in managed watersheds.

Road surface erosion is particularly affected by traffic, which increases sediment yields substantially (Reid and Dunne 1984). Other important factors that affect road surface erosion include condition of the road surface, timing of when the roads are used in relation to rainfall, road prism moisture content, location of the road relative to watercourses, methods used to construct the road, and steepness on which the road is located.

3. Hatcheries

Hatchery operations potentially conflict with salmon recovery in the action area. Three large mitigation hatcheries release roughly 14,215,000 hatchery salmonids into SONCC coho salmon ESU rivers annually. Additionally, a few smaller hatcheries, such as Mad River Hatchery and Rowdy Creek Hatchery (Smith River) add to the production of hatchery fish. Both intra- and inter-specific interactions between hatchery salmon and SONCC coho salmon occur in freshwater and saltwater.

Spawning by hatchery salmon is often not controlled (ISAB 2002). Hatchery fish also stray into other rivers and streams, transferring genes from hatchery populations into naturally spawning populations (Pearse et al. 2007). This is problematic for wild fish because hatchery programs alter the genetic composition (Reisenbichler and Rubin 1999, Ford 2002), phenotypic traits (Hard et al. 2000, Kostow 2004), and behavior (Berejikian et al. 1996, Jonsson 1997) of reared fish. These genetic interactions between hatchery and naturally produced stocks decrease the amount of genetic and phenotypic diversity of a species by homogenizing once disparate traits of hatchery and natural fish. The result has been progeny with lower survival (McGinnity et al. 2003, Kostow 2004) and ultimately, a reduction in the fitness of the natural stock (Reisenbichler and McIntyre 1977, Chilcote 2003, Araki et al. 2007) and outbreeding depression (Reisenbichler and Rubin 1999).

Flagg et al. (2000) found that, except in situations of low wild fish density, increasing releases of hatchery fish leads to displacement of wild fish from portions of their habitat. Competition between hatchery- and naturally-produced salmonids can result in reduced growth of naturally produced fish (McMichael et al. 1997). Kostow et al. (2003) and Kostow and Zhou (2006) found that over the duration of the steelhead hatchery program on the Clackamas River, Oregon, the number of hatchery steelhead in the upper basin regularly caused the total number of steelhead to exceed carrying capacity, triggering density-dependent mechanisms that impacted the natural population. Competition between hatchery and natural salmonids in the ocean can lead to density-dependent mechanisms that affect natural salmonid populations, especially during periods of poor ocean conditions (Beamish et al. 1997a, Levin et al. 2001, Sweeting et al. 2003).

NMFS specifically identified the past practices of the Mad River Hatchery as potentially damaging to NC steelhead. CDFG out-planted non-indigenous Mad River Hatchery brood stocks to other streams within the ESU, and attempted to cultivate a run of non-indigenous summer steelhead within the Mad River. CDFG ended these practices in 1996. The currently operating Mad River Hatchery, Trinity River Hatchery and Iron Gate Hatchery operate in the action area and have all been identified as having potentially harmful effects to wild salmon populations.

4. Water Diversions and Habitat Blockages

Stream-flow diversions are common throughout the species' ranges. Unscreened diversions for agricultural, domestic and industrial uses are a significant factor for salmonid declines in many basins. Reduced stream-flows due to diversions reduce the amount of habitat available to salmonids and can degrade water quality, such as causing water temperatures to elevate more easily. Reductions in the water quantity will reduce the carrying capacity of the affected stream reach. Where warm return flows enter the stream, fish may seek reaches with cooler water, thus increasing competitive pressures in other areas.

Habitat blockages have occurred in relation to road construction as discussed previously. However, hydropower, flood control, and water supply dams of different municipal and private entities, particularly in the Klamath Basin, have permanently blocked or hindered salmonid access to historical spawning and rearing grounds. Since 1908, the construction of the Potter Valley Project dams has blocked access to a majority of the historic salmonid habitat within the mainstem Eel River watershed. The percentage of habitat lost blocked by dams is likely greatest for steelhead because steelhead were more extensively distributed upstream than Chinook or coho salmon. As a result of migration barriers, salmon and steelhead populations have been confined to lower elevation mainstems that historically only were used for migration and rearing. Population abundances have declined in many streams due to decreased quantity, quality, and spatial distribution of spawning and rearing habitat (Lindley et al. 2007). Higher temperatures at these lower elevations during late-summer and fall are also a major stressor to adult and juvenile salmonids.

5. Predation

Predation was not believed to have played a major role in the decline of salmon populations; however, it may have had substantial impacts at local levels. For example, Higgins et al. (1992) and CDFG (1994) reported that Sacramento River pikeminnow have been found in the Eel River basin and are considered a major threat to native salmonids. Furthermore, populations of California sea lions and Pacific harbor seals, known predators of salmonids which occur in most estuaries and rivers where salmonid runs occur on the West Coast, have increased to historical levels because harvest of these animals has been prohibited by the Marine Mammal Protection Act of 1972 (Fresh 1997). However, salmonids appear to be a minor component of the diet of marine mammals (Scheffer and Sperry 1931). In the final rule listing the SONCC coho salmon ESU (62 FR 24588, May 6, 1997), for example, NMFS indicated that it was unlikely that pinniped predation was a significant factor in the decline of coho salmon on the west coast, although they may be a threat to existing depressed local populations. NMFS (1997) determined that although pinniped predation did not cause the decline of salmonid populations, predation may preclude recovery of these populations in localized areas where they co-occur with salmonids (especially where salmonids concentrate or passage may be constricted). Specific areas where pinniped predation may preclude recovery cannot be determined without extensive studies.

Normally, predators play an important role in the ecosystem, culling out unfit individuals, thereby strengthening the species as a whole. The increased impact of certain predators has been, to a large degree, the result of ecosystem modification. Therefore, it would seem more likely that increased predation is but a symptom of a much larger problem, namely, habitat modification and a decrease in water quantity and quality. With the decrease in quality riverine and estuarine habitats, increased predation by freshwater, avian, and marine predators will occur. Without adequate avoidance habitat (*e.g.*, deep pools and estuaries, and undercut banks) and adequate migration and rearing flows, predation may play a role in the reduction of some salmonid populations.

6. Disease

Relative to effects of overfishing, habitat degradation, and hatchery practices, disease is not believed to have been a major cause in the decline of salmon populations. However, disease may have substantial impacts in some areas and may limit recovery of local salmon populations. Although naturally occurring, many of the disease issues salmon and steelhead currently face have been exacerbated by human-induced environmental factors such as water regulation (damming and diverting) and habitat alteration.

Salmonids are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment. However, disease outbreaks result only when the complex interaction among host, pathogen, and environment is altered. Natural populations of salmonids have co-evolved with pathogens that are endemic to the areas salmonids inhabit and have developed levels of resistance to them. In general, diseases do not cause significant mortality in native salmonid stocks in natural habitats (Bryant 1994, Shapovalov and Taft 1954), however, our understanding of mortality caused by pathogens in the wild is limited by the difficulty in determining the proximate and ultimate causes of death (*e.g.* when fish weakened by disease are consumed by predators). Within the last few decades, the introduction and prevalence of disease into wild stocks has become an increasing concern.

Ceratomyxosis, which is caused by *C. shasta*, has recently been identified as one of the most significant disease for juvenile salmon due to its prevalence and impacts in the Klamath Basin (Nichols et al. 2007). Mortality rates of hatchery coho from temporary and longer term exposures at various locations in the Klamath River vary between location, months and years, but are consistently high (10-90 percent; Bartholomew 2005). Adults in the Klamath basin are also largely impacted by disease, primarily from the common pathogens *Ichthyopthirius multifilis* (Ich) and *Flavobacterium columnare* (columnaris) (NRC 2003). These pathogens were responsible for the 2002 fish kill on the Klamath River. Adult mortality from ich and columnaris are not as common as juvenile mortality from *C. Shasta* or *Parvicapsula minibicornis*. Very little current or historical information exists to quantify changes in infection levels and mortality rates attributable to these diseases for salmonids. However, studies suggest that naturally spawned fish tend to be less susceptible to pathogens than hatchery-reared fish (Sanders et al. 1992).

7. Commercial and Recreational Fisheries

Salmon and steelhead once supported important tribal, commercial, and recreation fisheries. Over-utilization including harvest of adult NC steelhead, CC Chinook salmon, and SONCC coho for commercial and recreational fisheries has been identified as a significant factor in their decline. The proportion of harvest taken by sport and commercial harvesters has varied over the years according to abundance and social and economic priorities. Steelhead are rarely caught in the ocean fisheries. Ocean salmon fisheries are managed by NMFS to achieve Federal conservation goals for west coast salmon in the Pacific Coast Salmon Fishery Management Plan (FMP). The goals specify numbers of adults that must be allowed to spawn annually, or maximum allowable adult harvest rates. The key stocks in California are Klamath River fall-run Chinook salmon and Sacramento River fall-run Chinook salmon. In addition to the FMP goals, salmon fisheries must meet requirements developed through NMFS' intra-agency section 7 consultations.

NMFS' ESA consultation standard requires that the projected ocean harvest rates on age-4 Klamath River fall Chinook not exceed 16 percent. CDFG is developing an assessment and monitoring program for the Eel, Mattole, Mad, and Smith Rivers Fall and Spring Chinook to better develop management goals for harvest (PFMC 2006).

In addition to the reduction in numbers of spawners, ocean salmon fisheries may reduce the viability of Chinook salmon populations through negative effects on demographics. The capture of immature fish by ocean fisheries results in a reduction in the proportion of a cohort that spawns as older, larger fish. The reduction in the average age of spawning would be further intensified by genetic changes in the population due to the heritability of age of maturation (Ricker 1980, Hankin and McKelvey 1985, Hankin and Healey 1986). The higher productivity of larger and older female Chinook salmon results from the larger size and number of eggs they carry (Healy and Heard 1984). In addition larger, older salmon can spawn in larger substrates and create deeper egg pockets (Van den Berge and Gross 1984, Ricker 1980, Shelton 1955) that reduces scour potential. Reduced scour potential may be especially important to the productivity of redds in areas subject to high sediment loads and scour, such as those found in streams included in the action area for this consultation.

Ocean exploitation rates for coho salmon have dropped substantially in response to the non-retention regulations put in place in 1994 as well as general reductions in Chinook-directed effort. River harvest of wild coho salmon has not been allowed within the SONCC coho salmon ESU since 1994, with the exception of sanctioned tribal harvest for subsistence, ceremonial, and commercial purposes by the Yurok, Hoopa Valley, and Karuk tribes (CDFG 2002). SONCC-origin coho salmon that migrate north of Cape Blanco experience incidental morality due to hooking and handling in this fishery; however, total incidental mortality from this fishery and Chinook-directed fisheries north of Humbug Mountain, Oregon has been estimated to be less than seven percent of the total mortality of coho salmon since 1999 (PFMC 1999, 2000).

Since 1998, total fishery impacts have been limited to no more than 13 percent on Rogue/Klamath hatchery coho salmon (surrogate stock) and no retention of coho salmon in California ocean fisheries. Only marked hatchery coho salmon are allowed to be harvested in the Rogue and Klamath rivers. All other recreational coho salmon fisheries in the Oregon portion of the ESU are prohibited. Recovery management may last more than 10 years even with no fishery impacts due to loss or deterioration of significant portions of freshwater habitat and ongoing unfavorable marine conditions.

Coho salmon harvested by Native American tribes are primarily incidental to larger Chinook salmon subsistence fisheries in the Klamath and Trinity rivers. In neither basin is tribal harvest considered to be a major factor for the decline of coho salmon (Moyle et al. 2008). The Yurok fishery has been monitored since 1992 and during that time harvest has ranged from 27 to 1,168 fish caught annually. Based on estimates of upstream escapement (in-river spawners and hatchery returns) this fishery is thought to amount to an average harvest rate of 4.4 percent from 1992 to 2003 when these fish were monitored from Weitchpec downstream to the ocean (CDFG 2004). Harvest management practiced by tribes is conservative and has resulted in limited impacts on stocks.

The commercial and recreational ocean fisheries for salmon were closed in 2008 due to record low returns of Sacramento River fall-run Chinook, and were extended through the 2009-2010 fishing season. The only exception to the 2009-2010 closure was a ten-day recreational ocean salmon season along the northern California coast targeting Klamath River fall-run Chinook, which was a result of the number of projected spawners surpassing conservation goals. The closure of the commercial and recreational fisheries is believed to decrease incidental take of listed salmonids, and therefore assist in their recovery.

8. Climate Change

Climate change is postulated to have a negative impact on salmonids throughout the Pacific Northwest due to large reductions in available freshwater habitat (Battin et al. 2007).

Widespread declines in springtime snow water equivalent (SWE), which is the amount of water contained in the snowpack, have occurred in much of the North American West since the 1920s, especially since mid-century (Knowles and Cayan 2004, Mote 2006). This decrease in SWE can be largely attributed to a general warming trend in the western United States since the early 1900s (Mote et al. 2005, Regonda et al. 2005, Mote 2006), even though there have been modest upward precipitation trends in the western United States since the early 1900s (Hamlet et al. 2005). The largest decreases in SWE are taking place at low to mid elevations (Mote 2006, Van Kirk and Naman 2008) because the warming trend overwhelms the effects of increased precipitation (Hamlet et al. 2005, Mote et al. 2005, Mote 2006). These climactic changes have resulted in earlier onsets of springtime snowmelt and streamflow across western North America (Hamlet and Lettenmaier 1999, Regonda et al. 2005, Stewart et al. 2004), as well as lower flows in the summer (Hamlet and Lettenmaier 1999, Stewart et al. 2004).

The projected runoff-timing trends over the course of the twenty first century are most pronounced in the Pacific Northwest, Sierra Nevada, and Rocky Mountain regions, where the eventual temporal centroid of streamflow (*i.e.*, peak streamflow) change amounts to 20 to 40 days in many streams (Stewart et al. 2004). Although climate models diverge with respect to future trends in precipitation, there is widespread agreement that the trend toward lower SWE and earlier snowmelt will continue (Zhu et al. 2005, Vicuna et al. 2007). Thus, availability of water resources under future climate scenarios is expected to be most limited during the late summer (Gleick and Chalecki 1999, Miles et al. 2000). A one-month advance in timing centroid of streamflow would also increase the length of the summer drought that characterizes much of western North America, with important consequences for water supply, ecosystem, and wildfire management (Stewart et al. 2004). These changes in peak streamflow timing and snowpack will negatively impact salmonid populations due to habitat loss associated with lower water flows, higher stream temperatures, and increased human demand for water resources.

The global effects of climate change on river systems and salmon are often superimposed upon the local effects of logging, water utilization, harvesting, hatchery interactions, and development within river systems (Bradford and Irvine 2000, Mayer 2008, Van Kirk and Naman 2008). For example, total water withdrawal in California, Idaho, Oregon and Washington increased 82 percent between 1950 and 2000, with irrigation accounting for nearly half of this increase (MacKichan 1951, Hutson et al. 2004), while during the same period climate change was taking place.

9. Ocean Conditions

Variability in ocean productivity has been shown to affect fisheries production both positively and negatively (Chavez et al. 2003). Beamish and Bouillion (1993) showed a strong correlation between North Pacific salmon production and marine environmental factors from 1925 to 1989. Beamish et al. (1997b) noted decadal-scale changes in the production of Fraser River sockeye salmon that they attributed to changes in the productivity of the marine environment. Warm ocean regimes are characterized by lower ocean productivity (Behrenfeld et al. 2006, Wells et al. 2006), which may affect salmon by limiting the availability of nutrients regulating the food supply, thereby increasing competition for food (Beamish and Mahnken 2001). Data from across the range of coho salmon on the coast of California and Oregon reveal there was a 72 percent decline in returning adults in 2007/08 compared to the same cohort in 2004/05 (MacFarlane et al. 2008). The Wells Ocean Productivity Index, an accurate measure of Central California ocean productivity, revealed poor conditions during the spring and summer of 2006, when juvenile coho salmon and Chinook salmon from the 2004/05 spawn entered the ocean (McFarlane et al. 2008). Data gathered by NMFS suggests that strong upwelling in the spring of 2007 may have resulted in better ocean conditions for the 2007 coho salmon cohort (NMFS 2008). The quick response of salmonid populations to changes in ocean conditions (MacFarlane et al. 2008) strongly suggests that density dependent mortality of salmonids is a mechanism at work in the ocean (Beamish et al. 1997a, Levin et al. 2001, Greene and Beechie 2004).

10. <u>Marine Derived Nutrients</u>

Marine-derived nutrients (MDN) are nutrients that are accumulated in the biomass of salmonids while they are in the ocean and are then transferred to their freshwater spawning sites where the salmon die. The return of salmonids to rivers makes a significant contribution to the flora and fauna of both terrestrial and riverine ecosystems (Gresh et al. 2000), and has been shown to be vital for the growth of juvenile salmonids (Bilby et al. 1996, 1998). Evidence of the role of MDN and energy in ecosystems suggests this deficit may result in an ecosystem failure contributing to the downward spiral of salmonid abundance (Bilby et al. 1996). Reduction of MDN to watersheds is a consequence of the past century of decline in salmon abundance (Gresh et al. 2000).

C. Viability of the ESUs/DPS

In order to determine the current viability of each ESU or DPS, we use the concept of a Viable Salmonid Population (VSP) and the parameters for evaluating populations described by McElhany et al. (2000). Viable salmonid populations are described in terms of four parameters: abundance, population productivity, spatial structure, and diversity. These parameters are predictors of extinction risk, and reflect general biological and ecological processes that are critical to the growth and survival of salmon (McElhany et al. 2000). Because some of the parameters are related or overlap, the evaluation is at times necessarily repetitive. Viable ESUs are defined by some combination of multiple populations, at least some of which exceed “viable” thresholds, and that have appropriate geographic distribution, protection from catastrophic events, and diversity of life histories and other genetic expression.

VSP Parameter 1: Population Size

Information about population size provides an indication of the type of extinction risk that a population faces. For instance, smaller populations are at a greater risk of extinction than large populations because the processes that affect populations operate differently in small populations than in large populations (McElhany et al. 2000). One risk of low population sizes is depensation. Depensation occurs when populations are reduced to very low densities and per capita growth rates decrease as a result of a variety of mechanisms [*e.g.*, failure to find mates and therefore reduced probability of fertilization, failure to saturate predator populations (Liermann and Hilborn 2001). Depensation results in negative feedback that accelerates a decline toward extinction (Williams et al. 2008).

The final rule for the ESA listing of the CC Chinook ESU (70 FR 37160, June 28, 2005) stated "an assessment of the effects of [multiple] small artificial propagation programs on the viability of the ESU in-total concluded that they collectively decrease risk to some degree by contributing to local increases in abundance . . ." However, McElhany et al. (2000) cautioned "that the ESA's primary focus is on natural populations in their native ecosystems, so when we evaluate abundance to help determine VSP status, it is essential to focus on naturally produced fish (*i.e.*, the progeny of naturally-spawning parents)." Based on these guidance documents, to the extent that hatchery-reared parents may boost production of naturally produced fish if and when they spawn in the wild, they may benefit the VSP parameter of population size. However, a population cannot be considered viable unless it has the minimum number of naturally produced spawners identified in recent guidance documents (Spence et al. 2008, Williams et al. 2008).

Although the operation of a hatchery tends to increase the abundance of returning adults (70 FR 37160), the reproductive success of hatchery-born salmonids spawning in the wild is far less than that of naturally produced ones (Araki et al. 2007). As a result, the higher the proportion of hatchery-born spawners, the lower the productivity of the population, as demonstrated by Chilcote (2003). Chilcote (2003) examined the actual number of spawners and subsequent recruits over 23 years in 12 populations of Oregon steelhead with varying proportions of hatchery-origin spawners and determined ". . . a spawning population comprised of equal numbers of hatchery and wild fish would produce 63 percent fewer recruits per spawner than one comprised entirely of wild fish."

VSP Parameter 2: Population Productivity

The productivity of a population (i.e., production over the entire life cycle) can reflect conditions (e.g., environmental conditions) that influence the dynamics of a population and determine abundance. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape and habitats in which it exists and its response to those habitats (McElhany et al. 2000). In general, declining productivity equates to declining population abundance. Understanding the spatial structure of a population is important because the population structure can affect evolutionary processes and, therefore, alter the ability of a population to adapt to spatial or temporal changes in the species' environment (McElhany et al.

2000).

VSP Parameter 3: Spatial Structure

Understanding the spatial structure of a population is important because the population structure can affect evolutionary processes and, therefore, alter the ability of a population to adapt to spatial or temporal changes in the species' environment (McElhany et al. 2000). Status reviews for the SONCC coho salmon ESU, the CC Chinook salmon ESU, and the NC steelhead DPS concluded data were insufficient to set specific population spatial structure targets (Spence et al. 2008, Williams et al. 2008). In the absence of such targets, McElhany et al. (2000) suggested the following: "As a default, historic spatial processes should be preserved because we assume that the historical population structure was sustainable but we do not know whether a novel spatial structure will be."

VSP Parameter 4: Diversity

Diversity, both genetic and behavioral, is critical to success in a changing environment. Salmonids express variation in a suite of traits, such as anadromy, morphology, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, and physiology and molecular genetic characteristics. The more diverse these traits (or the more these traits are not restricted), the more diverse a population is, and the more likely that individuals, and therefore the species, would survive and reproduce in the face of environmental variation (McElhany et al. 2000). However, when this diversity is reduced due to loss of entire life history strategies or to loss of habitat used by fish exhibiting variation in life history traits, the species is in all probability less able to survive and reproduce given environmental variation. Negative effects to genetic diversity can result from hatchery production and stocking of hatchery-bred fish into wild streams. Hatchery-reared fish may be less genetically diverse than wild fish due to artificial selection, and may have originated in areas with different environmental conditions. Once in the hatchery, artificial selection for fish which survive well in the hatchery is likely to occur (Allendorf and Ryman 1987). If the hatchery-bred fish later interbreed with wild fish, they can reduce the genetic diversity of the wild population. Even if the overall genetic diversity of the wild population is unchanged, the introduction of non-native or less diverse genetic material into a native salmonid population can "dilute" the native population's adaptation to its local environment and make it less able to survive and reproduce (McElhany et al. 2000).

Genetic variability of wild stocks is naturally altered by straying from natural populations in nearby streams, which results in gene flow and often sustains or even increases the genetic diversity of a population over time. Straying is a normal and important part of the life history and evolution of Pacific salmon (Quinn 2005), but human activities can increase the rate of straying and cause more genetic interaction between populations than would naturally occur.

Founding hatchery populations with broodstock from outside the watershed can make straying more common, as seen in the Columbia River (Pascual et al. 1995). Therefore, the genetic makeup of hatchery steelhead from the Mad River could detrimentally affect steelhead in many other rivers within and even outside the geographic range of the NC steelhead DPS. Excessive straying can also be detrimental to wild fish populations born in their natal streams. When habitat becomes degraded, or inaccessible due to dams or road crossings, salmonid spatial distribution can become fragmented. In this situation, straying into non-natal streams is likely to increase when salmonids are denied access to their natal areas and are forced to enter other streams that are accessible. Increased stray rates would be expected to reduce population viability, particularly if the strays are accessing unsuitable habitat or are mating with genetically unrelated individuals (McElhany et al. 2000).

1. <u>NC Steelhead DPS</u>

a. *Population Abundance of NC Steelhead*

Steelhead abundance has been monitored at three dams in the NC steelhead ESU since the 1930s. Reviewers participating in the most recent status review determined these data showed population abundances were low relative to historical estimates, and that summer-run steelhead abundance was very low (Good et al. 2005). Regarding abundance, reviewers concluded that "although there are older data for several of the larger river systems that imply run sizes became much reduced since the early twentieth century, there are no recent data suggesting much of an improvement" (Good et al. 2005). Experts consulted during the status review gave this DPS a risk score of 3.7 (out of 5, with 5 equaling the highest risk) for the abundance category (Good et al. 2005), indicating its reduced abundance contributes significantly to long-term risk of extinction, and may contribute to short-term risk of extinction in the foreseeable future. NMFS concludes this DPS falls far short of McElhany's 'default' goal of historic population numbers and distribution and is therefore not viable in regards to the population size VSP parameter.

b. Productivity of NC Steelhead

Populations of NC steelhead have declined substantially from historic levels. Experts consulted during the status review gave this DPS as risk score of 3.3 (out of 5) for the growth rate/productivity VSP category (Good et al. 2005), indicating its current impaired productivity level contributes significantly to long-term risk of extinction and may contribute to short-term risk of extinction in the foreseeable future. As productivity does not appear sufficient to maintain viable abundances in many NC steelhead populations, NMFS concludes this DPS is not viable in regards to the population productivity VSP parameter.

c. Spatial Structure of NC Steelhead

Experts consulted during the most recent status review gave this DPS a mean risk score of 2.2 (out of 5) for the spatial structure and connectivity VSP category (Good et al. 2005), indicating it is unlikely this factor contributes significantly to risk of extinction by itself, but there is some concern that it may, in combination with other factors. Blockages to fish passage exist on two major rivers in the DPS and on numerous small tributaries (Good et al. 2005). These blockages degrade the spatial structure and connectivity of populations within the DPS. As the 'default' historic spatial processes described by McElhany et al. (2000) have likely not been preserved, NMFS concludes this DPS is not viable in regards to the spatial structure VSP parameter.

d. Diversity of NC Steelhead

Millions of steelhead from outside the Mad River or outside the DPS have been stocked into rivers in the NC steelhead DPS many times since the 1970s. Bjorkstedt et al. (2005) documented 39 separate releases of this kind, and many of these releases occurred over multiple years. Of particular concern is the practice of rearing Eel River-derived steelhead in a hatchery on the Mad River before restocking them into the Eel River (Bjorkstedt et al. 2005). Over 10 years, more than one-half million yearlings were reared and released in this way. This practice may have reduced the effectiveness of adult homing to the Eel River (Bjorkstedt et al. 2005). In addition, the abundance of summer-run steelhead was considered "very low" in 1996 (Good et al. 2005), indicating an important part of the life history diversity in this DPS may be at risk.

e. Summary of NC Steelhead DPS Viability

Based on the above descriptions of the population viability parameters, and qualitative viability criteria presented in Spence et al. (2008), NMFS believes that the NC steelhead DPS is currently not viable and is at an elevated risk of extinction.

2. <u>CC Chinook Salmon ESU</u>

a. *Population Abundance of CC Chinook*

The most recent status review found continued evidence of: (1) low population sizes relative to historical abundance, (2) mixed trends in the few time series of abundance indices available for analysis, and (3) low abundances and potential extirpations of populations in the southern part of the ESU (Good et al. 2005). Experts consulted during the status review gave this ESU a mean risk score of 3.9 (out of 5) for the abundance category (Good et al. 2005), indicating its reduced abundance contributes significantly to long-term risk of extinction, and is likely to contribute to short-term risk of extinction in the foreseeable future. NMFS concludes this ESU falls far short of McElhany's 'default' goal of historic population numbers and distribution and is therefore not viable in regards to the population size VSP parameter.

b. *Productivity of CC Chinook*

Populations of CC Chinook salmon have declined substantially from historic levels. Experts consulted during the status review gave this ESU as risk score of 3.3 (out of 5) for the growth rate/productivity VSP category (Good et al. 2005), indicating its current impaired productivity level contributes significantly to long-term risk of extinction and may contribute to short-term risk of extinction in the foreseeable future. As productivity does not appear sufficient to maintain viable abundances in many CC Chinook salmon populations, NMFS concludes this ESU is not viable in regards to the population productivity VSP parameter.

c. *Spatial Structure of CC Chinook*

Experts consulted during the most recent status review gave this ESU a mean risk score of 3.2 (out of 5) for the spatial structure and connectivity VSP category (Good et al. 2005), indicating its current spatial structure contributes significantly to long-term risk of extinction but does not in itself constitute a danger of extinction in the near future. However, Good et al. (2005) found that "reduction in geographic distribution, particularly for spring-run Chinook [salmon], and for basins in the southern portion of the ESU, continues to present substantial risk." As the 'default' historic spatial processes described by McElhany et al. (2000) have likely not been preserved, due to the reduction in geographic distribution described above, NMFS concludes this ESU is not viable in regards to the spatial structure VSP parameter.

d. *Diversity of CC Chinook*

As of 2005, Bjorkstedt et al. concluded "most recent and ongoing artificial propagation efforts in the CC Chinook ESU are small in scale and restricted to supplementing depressed populations with progeny of local broodstock (2005)." The only current hatchery program for CC Chinook salmon is a supplementation program that uses local broodstock to boost populations in a tributary to the South Fork of the Eel River (Spence et al. 2008). The low hatchery production observed in the ESU is less likely to mask trends in ESU population structure and pose risks to ESU diversity than if hatchery production were higher, making hatchery production less of a concern for this ESU than others. The BRT did have concerns with respect to diversity that were based largely on the loss of spring-run Chinook salmon in the Eel River basin and elsewhere in the ESU, and to a lesser degree on the potential loss of diversity concurrent with low abundance or extirpation of populations in the southern portion of the ESU (Good et al. 2005)."

Experts consulted during the status review gave this ESU a mean risk score of 3.1 (out of 5) for the diversity VSP category (Good et al. 2005). This score indicates the ESU's current genetic variability and variation in life history factors contribute significantly to long-term risk of extinction but do not, in themselves, constitute a danger of extinction in the near future. Low genetic diversity is therefore not considered the most important factor to this ESU's viability. However, Spence et al. (2008) expressed concern over the loss of spring-run populations in this ESU. NMFS concludes the current behavioral diversity in this ESU is much reduced compared to historic levels, so by McElhany's criteria it is not viable in regards to the diversity VSP parameter.

e. *Summary of CC Chinook ESU Viability*

Based on the above descriptions of the population viability parameters, and qualitative viability criteria presented in Spence et al. (2008), NMFS believes that the CC Chinook salmon ESU is currently not viable and is at a moderate to high risk of extinction.

3. <u>SONCC Coho Salmon ESU</u>

In order to determine the current risk of extinction of the SONCC coho salmon ESU, the population viability criteria and the concept of Viable Salmonid Populations (VSP) for evaluating populations described by McElhany et al. (2000) are utilized. A viable salmonid population is defined as one that has a negligible risk of extinction over 100 years. Viable salmonid populations are described in terms of four parameters: abundance, population productivity, spatial structure, and diversity. These parameters are predictors of extinction risk, and reflect general biological and ecological processes that are critical to the growth and survival of salmon (McElhany et al. 2000).

a. *Population Abundance of SONCC Coho Salmon*

Quantitative population-level estimates of adult spawner abundance spanning more than 9 years are scarce for SONCC coho salmon. New data since publication of the previous status review (Good et al. 2005) consists of continuation of a few time series of adult abundance, expansion of efforts in coastal basins of Oregon to include SONCC coho salmon populations, and continuation and addition of several "population unit" scale monitoring efforts in California. Other than the Shasta River and Scott River adult counts, reliable current time series of naturally produced adult spawners are not available for the California portion of the SONCC ESU at the "population unit" scale.

Although long-term data on coho salmon abundance are scarce, the available monitoring data indicate that spawner abundance has declined for populations in this ESU. The longest existing time series at the population unit scale is from the past ten years for Shasta River (Figure 3), which has a significant negative trend. Available time series data on the Shasta River show low adult returns, of which two out of three cohorts are considered to be nearly extirpated (Chesney et al. 2009). The Shasta River population has declined in abundance by almost 50 percent from one generation to the next (Williams et al. 2011).

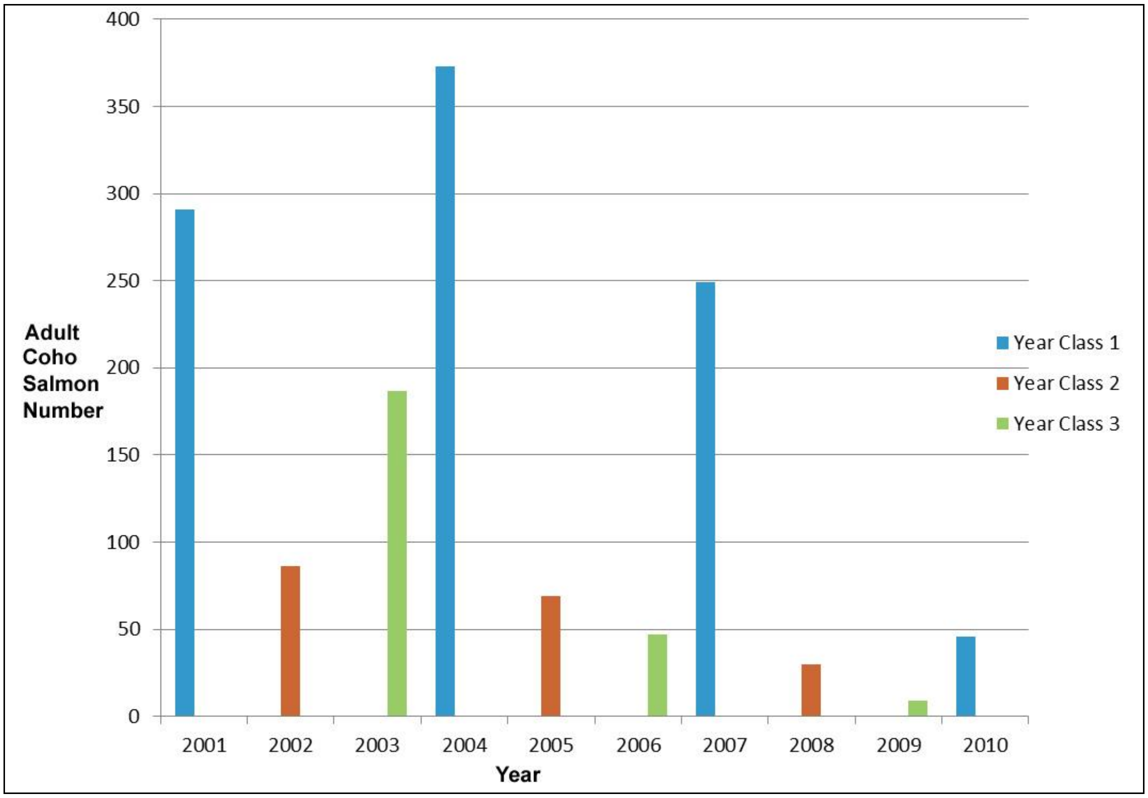

Figure 3. Video weir estimates of adult coho salmon in the Shasta River from 2001 through 2010 (from M. Knechtle, CDFG).

Two partial counts from Prairie Creek, a tributary of Redwood Creek; and Freshwater Creek, a tributary of Humboldt Bay show negative trends (figures 4 and 5, respectively). Data from the Rogue River basin also indicate recent negative trends. Estimates from Huntley Park in the Rogue River basin show a strong return year in 2004, followed by a decline to 394 fish in 2008, the lowest estimate since 1993 and the second lowest going back to 1980 in the time series (figure 6). The Huntley Park seine estimates provide the best overall assessment of naturally produced coho salmon spawner abundance in the basin (Oregon Department of Fish and Wildlife (ODFW) 2005). Four independent populations contribute to this count (Lower Rogue River, Illinois River, Middle Rogue and Applegate rivers, and Upper Rogue River). The 12-year average estimated wild adult coho salmon in the Rogue River basin between 1998 and 2009 to be 7,414 adults, which is well below historic abundance. Based on extrapolations from cannery pack, the Rogue River had an estimated adult coho salmon abundance of 114,000 in the late 1800s (Meengs and Lackey 2005).

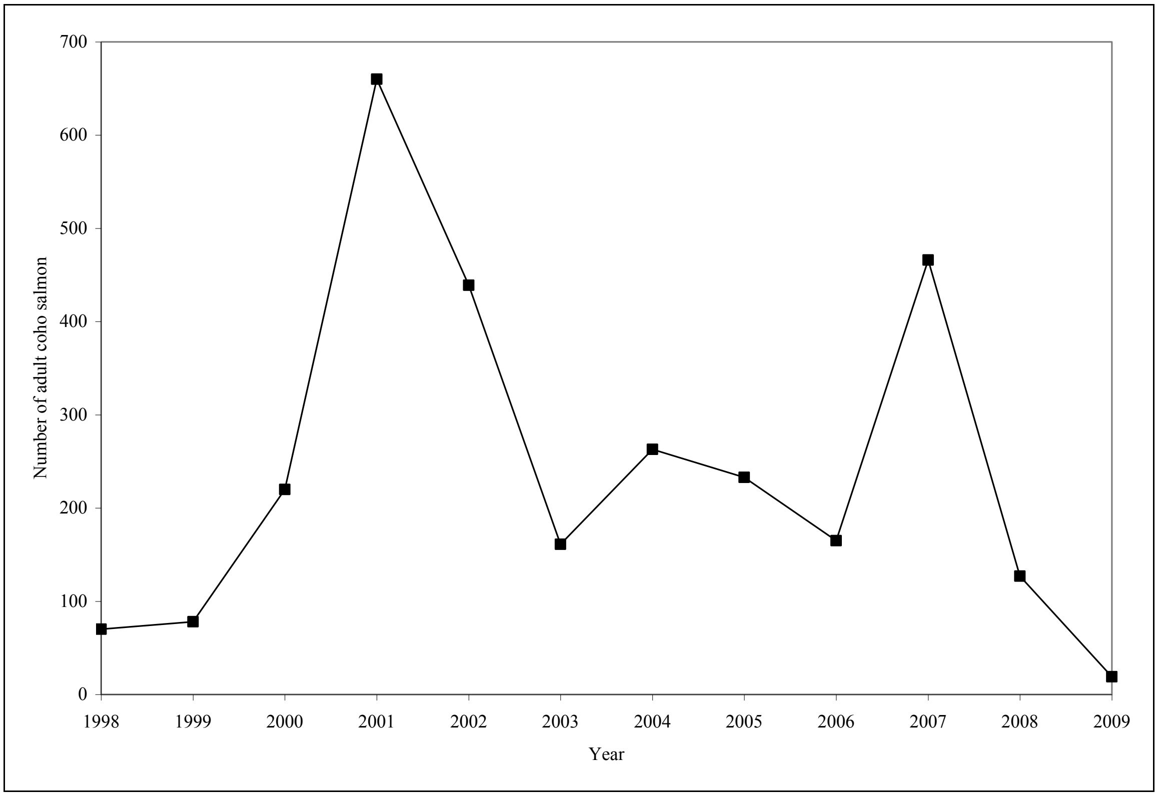

Figure 4. Estimate of spawning coho salmon in Prairie Creek from 1998 through 2009, a tributary to Redwood Creek, Humboldt County, California (Williams et al. 2011).

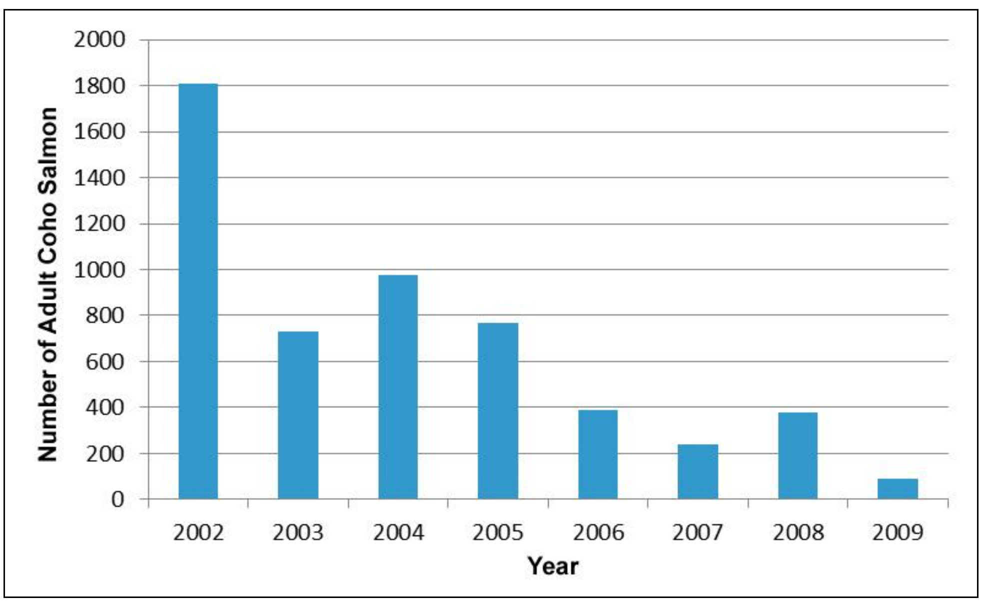

Figure 5. Estimated adult coho salmon returns to Freshwater Creek from 2002 through 2009, a tributary to Humboldt Bay (Ricker and Anderson 2011).

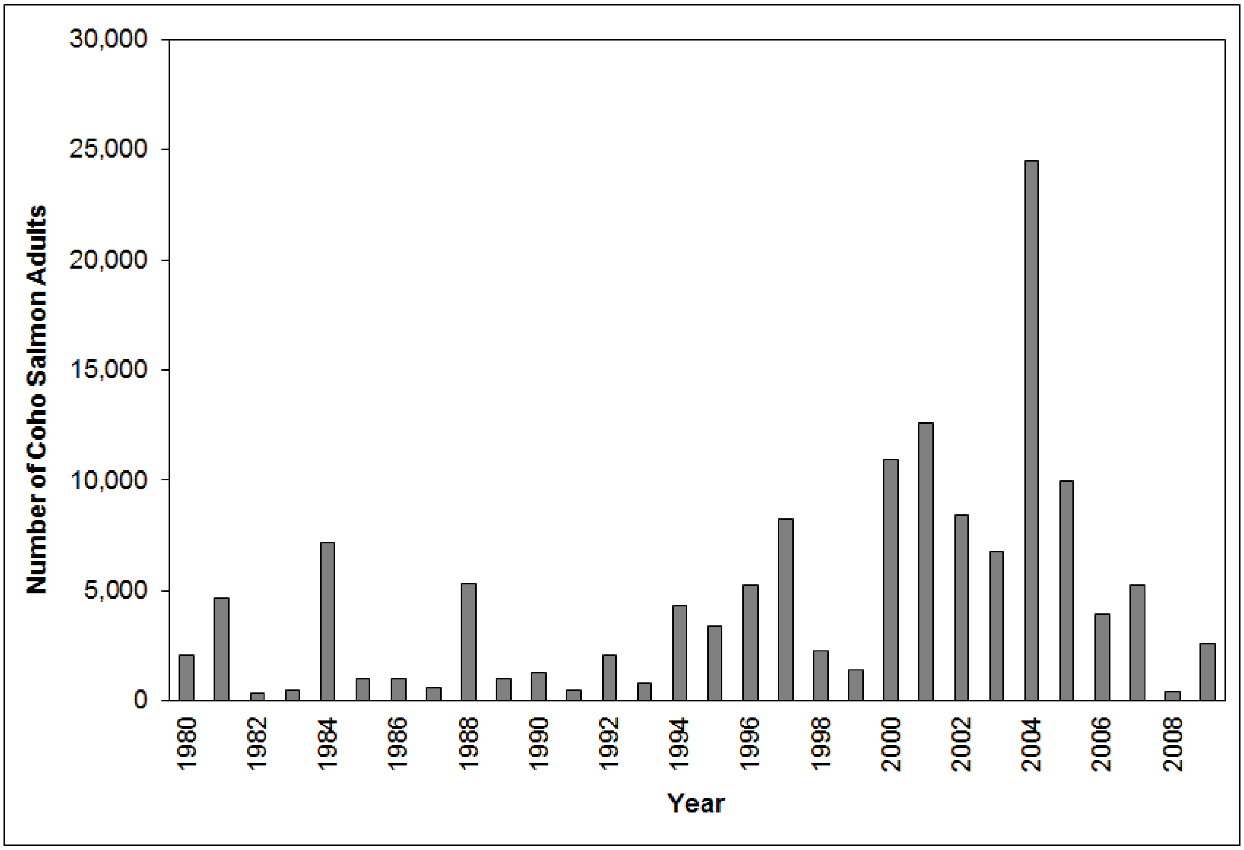

Figure 6. Estimated number of wild adult coho salmon in the Rogue River basin from 1980 through 2009. (Huntley Park sampling, ODFW 2010).

Though population-level estimates of abundance for most independent populations are lacking, the best available data indicate that none of the seven diversity strata appears to support a single viable population as defined by in the viability criteria. In fact, most of the 30 independent populations in the ESU are at high risk of extinction because they are below or likely below their depensation threshold.

Sharr et al. (2000) modeled the probability of extinction of most Oregon Coast natural populations and determined that as spawner density dropped below 4 fish per mile (2.4 spawners/km), the risk of extinction rises rapidly (Figure 7). When Chilcote (1999) tracked the collapse of four coho salmon populations in the Lower Columbia River, they found the depensation threshold was 2.4 spawners/km. Using spawner-recruit relationships from 14 populations of coho salmon, Barrowman et al. (2003) found evidence of depensatory effects when spawner densities are less than 1 female per km (2 spawners/km). Small-population demographic risks are very likely to be significant when spawner density is below 0.6 spawner per km (Wainwright et al. 2008), which Williams et al. (2008) estimates is approximately 1 spawner/IP-km and used this density for setting the depensation threshold. Because the depensation threshold for SONCC coho salmon populations is set at such a low density, populations that do not meet their depensation threshold are definitely at a high, if not a very high, risk of extinction.

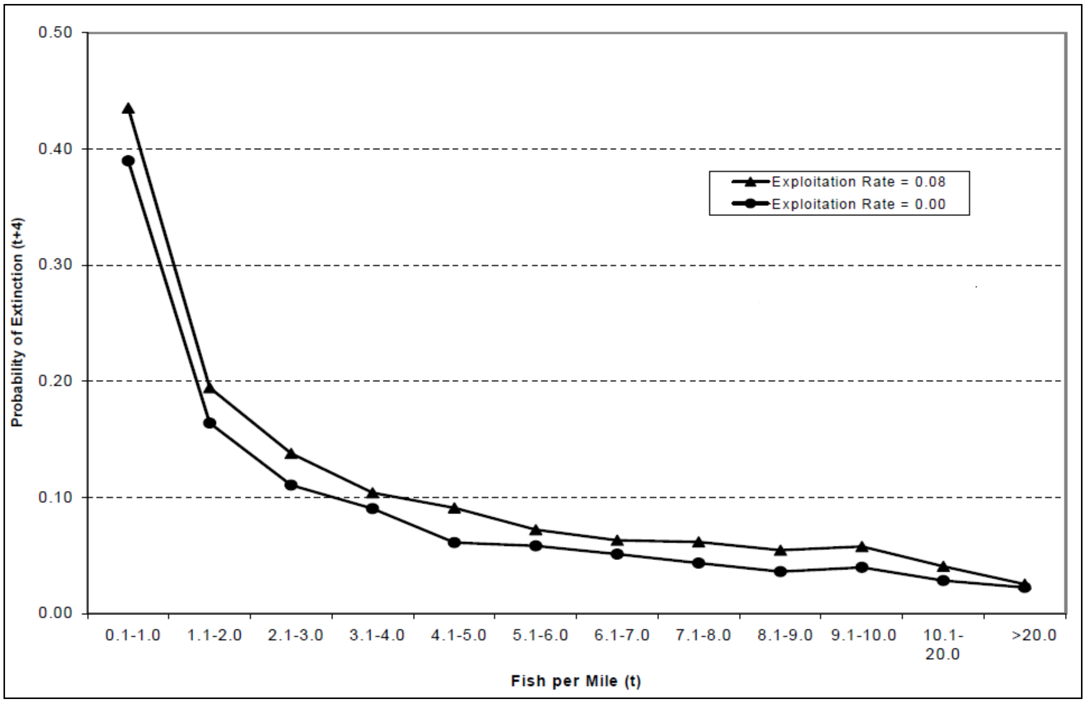

Figure 7. Probability of basin-level extinction of coho salmon populations in all Oregon coastal basins. Probability applies to four generations as a function of spawner density for exploitation rates of 0.00 and 0.08 (Sharr et al. 2000).

In addition, populations that are under depensation have increased likelihood of being extirpated. Extirpations have already occurred in the Eel River basin and are likely in the interior Klamath River basin for one or all year classes (*e.g.*, Shasta and Scott rivers), Bear River, and Mattole River. Coho salmon spawners in the Eel River watershed, which historically supported significant spawners (*e.g.*, 50,000 to 100,000 per year; Yoshiyama and Moyle 2010), have declined. Yoshiyama and Moyle (2010) concluded that coho salmon populations in the Eel River basin appear to be headed for extirpation by 2025. One of the four independent populations in this basin have already been extirpated (*i.e.*, Middle Fork Eel River; Moyle et al. 2008, Yoshiyama and Moyle 2010) and one population contains critically low numbers (*i.e.*, Upper Mainstem Eel River; with only a total of 7 coho salmon adults observed at the Van Arsdale Fish Station in over six decades; Jahn 2010). Although long-term spawner data are not available, both NMFS and CDFG believe the Lower Eel/Van Duzen River, Middle Mainstem Eel and Mainstem Eel river populations are very likely below the depensation threshold, and thus are at a high risk of extinction. The only population in the Eel River basin that is likely to be above its depensation threshold is the South Fork Eel River, which also has significantly declined from historical numbers (Figure 8).

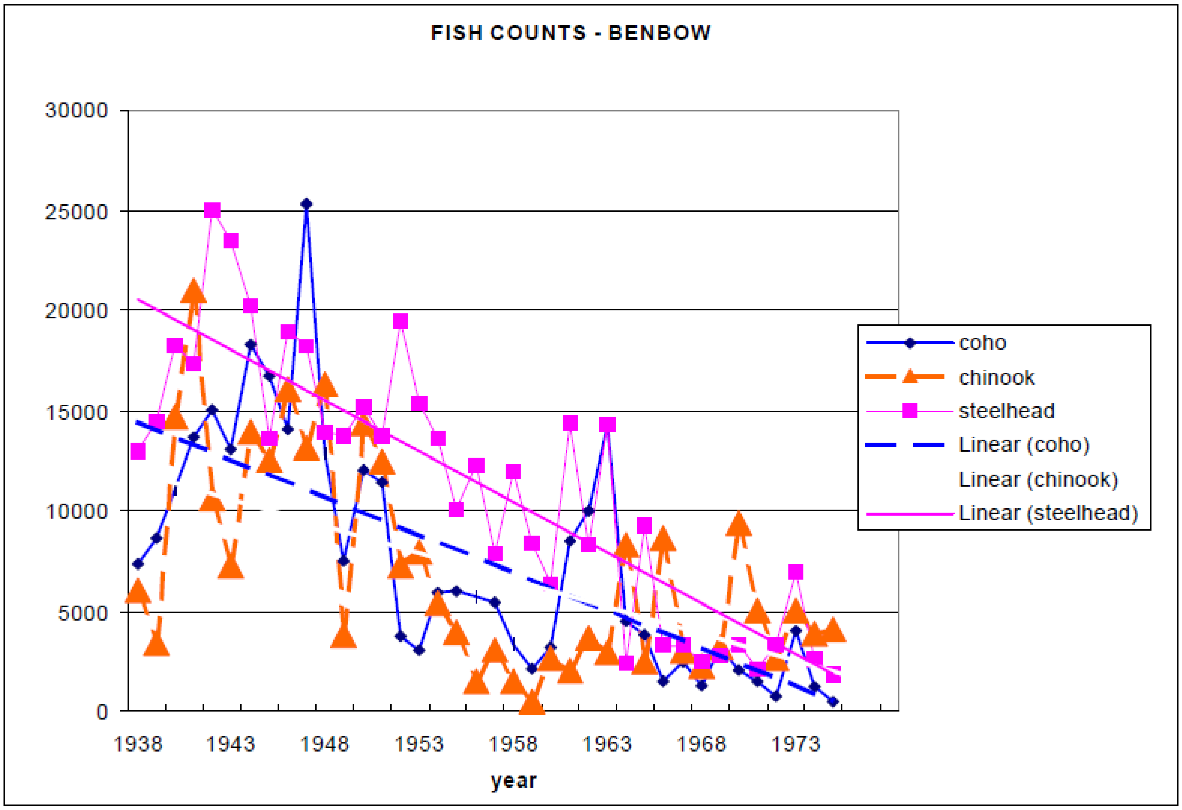

Figure 8. Fish counts at Benbow Fish Station, in the South Fork Eel River. Data are from 1938 to 1975. Graph from EPA 1999.

In addition to the Eel River basin, two other independent populations south of the Eel River basin, the Bear River and Mattole River populations, have similar trajectories. The Bear River population is likely extirpated or severely depressed. Despite multiple surveys over the years, no coho salmon have been found in the Bear River watershed (Ricker 2002, Bliesner et al. 2006). In 1996 and 2000, the CDFG surveyed most tributaries of Bear River, and did not find any coho salmon (CDFG 2004). In addition, CDFG sampled the mainstem and South Fork Bear River between 2001 and 2003 and found no coho salmon (Jong et al. 2008). In the Mattole River, surveys of live fish and carcasses since 1994 indicate the population is severely depressed and well below the depensation threshold of 250 spawners. Recent spawner surveys in the Mattole River resulted in only 3 and 9 coho salmon for 2009 and 2010, respectively. These low numbers, along with a recent decline since 2005, indicate that the Mattole River population is at a high risk of extinction.

Because the extinction risk of an ESU depends upon the extinction risk of its constituent independent populations (Williams et al. 2008) and the population abundance of most independent populations are below their depensation threshold, the SONCC coho salmon ESU is at high risk of extinction and is not viable.

b. *Productivity of SONCC Coho Salmon*

The productivity of a population (*i.e.*, production over the entire life cycle) can reflect conditions (*e.g.*, environmental conditions) that influence the dynamics of a population and determine abundance. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape and habitats in which it exists and its response to those habitats (McElhany et al. 2000). In general, declining productivity equates to declining population abundance. As discussed above in the *Population Abundance* section, available data indicates that many populations have declined, which reflects a declining productivity. For instance, the Shasta River population has declined in abundance by almost 50 percent in a single generation (Williams et al. 2011 and figure 3). Two partial counts from Prairie Creek, a tributary of Redwood Creek; and Freshwater Creek, a tributary of Humboldt Bay, show negative trends in abundance (figures 4, 5). Data from the Rogue River basin also indicate recent negative trends. In general, SONCC coho salmon have declined substantially from historic levels. Because productivity appears to be negative for most, if not all, SONCC coho salmon populations, NMFS considers this ESU to not be currently viable relative to population productivity.

c. *Spatial Structure of SONCC Coho Salmon*

The most recent status review for the SONCC coho salmon ESU concluded data were insufficient to set specific population spatial structure targets (Williams et al. 2008). In the absence of such targets, McElhany et al. (2000) suggested the following: "As a default, historical spatial processes should be preserved because we assume that the historical population structure was sustainable but we do not know whether a novel spatial structure will be." An ESU persists in places where it is able to track environmental changes, and becomes extinct if it fails to keep up with the shifting distribution of suitable habitat (Thomas 1994, Williams et al. 2008). If freshwater habitat shrinks due to climate change (Battin et al. 2007), certain areas such as inland rivers and streams could become inhospitable to coho salmon, which would change the spatial structure of the SONCC coho salmon ESU, having implications for the risk of species extinction.

Data is inadequate to determine whether the spatial distribution of SONCC coho salmon has changed since 2005. In 2005, Good et al. (2005) noted that they had strong indications that breeding groups have been lost from a significant percentage of streams within their historical range. Relatively low levels of observed presence in historically occupied coho salmon streams (32 to 56 percent from 1986 to 2000) indicate continued low abundance in the California portion of the SONCC coho salmon ESU. The relatively high occupancy rate of historical streams observed in brood year 2001 suggests that much habitat remains accessible to coho salmon (70 FR 37160, June 28, 2005). Brown et al. (1994) found survey information on 115 streams within the SONCC coho salmon ESU, of which 73 (64 percent) still supported coho salmon runs while 42 (36 percent) did not. The streams Brown et al. (1994) identified as lacking coho salmon runs were all tributaries of the Klamath River and Eel River basins. CDFG (2002) reported a decline in SONCC coho salmon occupancy, with the percent reduction dependent on the data sets used.

Although there is considerable year-to-year variation in estimated occupancy rates, it appears that there has been no dramatic change in the percent of coho salmon streams occupied from the late 1980s and early 1990s to 2000 (Good et al. 2005). However, the number of streams and rivers currently supporting coho salmon in this ESU has declined from historical levels, and watershed-specific extirpations of coho salmon have been documented (Brown et al. 1994, CDFG 2004, Good et al. 2005, Moyle et al. 2008, Yoshiyama and Moyle 2010). In summary, recent information for SONCC coho salmon indicates that their distribution within the ESU has been reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which they are now absent (NMFS 2001). However, extant populations can still be found in all major river basins within the ESU (70 FR 37160; June 28, 2005).

d. *Diversity of SONCC Coho Salmon*

The primary factors affecting the diversity of SONCC coho salmon appear to be low population abundance and the influence of hatcheries and out-of-basin introductions. Although the operation of a hatchery tends to increase the abundance of returning adults (70 FR 37160; June 28, 2005), the reproductive success of hatchery-born salmonids spawning in the wild can be less than that of naturally produced fish (Araki et al. 2007). As a result, the higher the proportion of hatchery-born spawners, the lower the overall productivity of the population, as demonstrated by Chilcote (2003). Williams et al. (2008), considered a population to be at least at a moderate risk of extinction if the contribution of hatchery coho salmon spawning in the wild exceeds 5 percent. Populations have a lower risk of extinction if no or negligible ecological or genetic effects resulting from past or current hatchery operations can be demonstrated. Because the main stocks in the SONCC coho salmon ESU (i.e., Rogue River, Klamath River, and Trinity River) remain heavily influenced by hatcheries and have little natural production in mainstem rivers (Weitkamp et al. 1995, Good et al. 2005), many of these populations are at high risk of extinction relative to the genetic diversity parameter.

In addition, some populations are extirpated or nearly extirpated (*i.e.*, Middle Fork Eel, Bear, and Upper Mainstem Eel rivers) and some brood years have low abundance or may even be absent in some areas (*e.g.*, Shasta River, Scott River, Mattole River, Mainstem Eel River), which further restricts the diversity of the ESU. The ESU's current genetic variability and variation in life history likely contribute significantly to long-term risk of extinction. Given the recent trends in abundance across the ESU, the genetic and life history diversity of populations is likely very low and is inadequate to contribute to a viable ESU.

e. *Summary of SONCC Coho Salmon ESU Viability*

Though population-level estimates of abundance for most independent populations are lacking, the best available data indicate that none of the seven diversity strata appears to support a single viable population as defined by the TRT's viability criteria. Integrating the four VSP parameters into the population viability criteria, as many as 25 out of 30 independent populations are at high risk of extinction and 5 are at moderate risk of extinction (table 3).

Table 3. SONCC coho salmon independent populations and their risk of extinction.

Northern Coastal Basin	Elk River		Population likely below depensation threshold[1]
	Lower Rogue River		
	Chetco River		
	Winchuck River		
Interior Rogue River	Illinois River		Though likely above the depensation threshold, these populations have a precipitous decline where spawners > 500 but declining at a rate of 10% per year over the last two generations. Rogue River populations reflect data from Huntley Park counts, which represents the entire Rogue River basin.
	Middle Rogue/Applegate rivers		
	Upper Rogue River		
Central Coastal Basin	Smith River		Population likely below depensation threshold[1]
	Lower Klamath River		Population likely below depensation threshold[1]
	Redwood Creek		Population above depensation threshold[1]
	Maple Creek/Big Lagoon		Population likely below depensation threshold[1]
	Little River		Population above depensation threshold[1]
	Mad River		Population likely below depensation threshold[1]
Interior Klamath	Middle Klamath River		Population above depensation threshold[1]
	Upper Klamath River		Population below depensation threshold[1] and hatchery fraction likely >5%
	Shasta River		
	Scott River		Population below depensation threshold[1]
	Salmon River		
Interior Trinity	Lower Trinity River		Population likely above depensation threshold[1]
	South Fork Trinity River		Population likely below depensation threshold[1]
	Upper Trinity River	High	Though above the depensation threshold, this population's hatchery fraction >5%
South Coastal Basin	Humboldt Bay tributaries	High	Though above the depensation threshold, this population has declined within the last two generations or is projected to decline within the next two generations (based on Freshwater Creek data if current trends continue) to annual run size ≤ 500 spawners.
	Lower Eel and Van Duzen rivers	High	Population below depensation threshold[1]
	Bear River	High	
	Mattole River	High	
Interior Eel	Mainstem Eel River	High	
	Middle Mainstem Eel River	High	

Stratum	Independent Populations	Extinction Risk	Population Viability Metric (Williams et al. 2008)
	Upper Mainstem Eel River	High	
	Middle Fork Eel River	High	
	South Fork Eel River	Moderate	Population above depensation threshold[1]

[1] Based on average spawner abundance over the past three years or best professional judgment of NMFS staff.

Based on the above discussion of the population viability parameters, and qualitative viability criteria presented in Williams et al. (2008), NMFS concludes that the SONCC coho salmon ESU is currently not viable and is at high risk of extinction.

The precipitous decline in abundance from historical levels and the poor status of population viability metrics in general are the main factors behind the extinction risk faced by SONCC coho salmon. The cause of the decline is likely from ocean conditions and the widespread degradation of habitat, particularly those habitat attributes that support the freshwater rearing life-stages of the species.

D. Description and Current Condition of Critical Habitat

1. Critical Habitat Description

This Opinion analyzes the effects of the Project on critical habitat for SONCC coho salmon (64 FR 24049, May 5, 1999), CC Chinook salmon (70 FR 52488, September 2, 2005), and NC steelhead (70 FR 52488, September 2, 2005). This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.2. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

The ESA defines conservation as "to use all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to the ESA are no longer necessary." As a result, NMFS approaches its "destruction and adverse modification" determinations by examining the effects of actions on the conservation value of the designated critical habitat, that is, the value of the critical habitat for the conservation of threatened or endangered species.

a. *Description SONCC Coho Salmon Critical Habitat*

Coho salmon critical habitat consists of: "the water, substrate, and adjacent riparian zone [in an ESU] . . . [below] longstanding, naturally impassable barriers (*i.e.*, natural waterfalls in existence for at least several hundred years)" (64 FR 24049, May 5, 1999). NMFS has excluded from coho salmon critical habitat designation all tribal lands in northern California and areas that are above certain dams which block access to historic habitats of listed salmonids. Critical habitat corresponds to all the water, river bed and bank areas, and riparian areas within the ESU boundaries except as noted above. Waterways include estuarine areas and tributaries. Adjacent riparian area is defined as "the area adjacent to a stream that provides the following functions: shade, sediment, nutrient, or chemical regulation, stream bank stability, and input of large woody debris or organic matter" (64 FR 24049, May 5, 1999). In other words, riparian areas are those areas that produce physical, biological, and chemical features that help to create biologically productive stream habitat for salmonids. PCEs for coho salmon critical habitat include juvenile summer and winter rearing areas, juvenile migration corridors, areas for growth and development to adulthood, adult migration corridors, and spawning areas (64 FR 24049, May 5, 1999). The current condition of critical habitat for SONCC coho salmon is discussed below in the *Conservation Value of the Critical Habitat* section.

b. Description of NC Steelhead and CC Chinook Critical Habitat

NMFS designated critical habitat for seven of the ESUs/DPSs of Pacific salmon and steelhead, including CC Chinook salmon, NC, CCC, and S-CCC steelhead in September 2005 (70 FR 52488, September 2, 2005). The method and criteria used to define critical habitat focused on identifying the biological or physical constituent elements of habitat that are essential to the conservation of the species. The aggregated physical and biological PCEs resulted from a list of specific PCEs necessary for conservation of the listed species and included all the biological and physical attributes necessary for productive systems supporting the completion of all salmonid life history stages. These specific PCEs were identified: freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, estuarine areas, nearshore marine areas; and offshore marine areas. Habitat areas within the geographic range of the ESU/DPSs having these attributes and occupied by the species were considered for designation. Steelhead critical habitat was designated throughout the watersheds occupied by the ESU/DPSs. In general, the extent of critical habitat conforms to the known distribution of NC, CCC, and S-CCC steelhead in streams, rivers, lagoons and estuaries (NMFS 2005, 70 FR 52488). In some cases, streams containing steelhead were not designated because the economic benefit of exclusion outweighed the benefits of designation. Native American lands and U.S. Department of Defense lands were also excluded.

2. <u>Conservation Value of Critical Habitat</u>

The essential habitat types of designated critical habitat for SONCC and CCC coho salmon and PCEs of designated critical habitat for NC, CCC, and S-CCC steelhead and CC Chinook salmon are those accessible freshwater habitat areas that support spawning, incubation and rearing, migratory corridors free of obstruction or excessive predation, and estuarine areas with good water quality and that are free of excessive predation. Timber harvest and associated activities, road construction, urbanization and increased impervious surfaces, migration barriers, water diversions, and large dams throughout a large portion of the freshwater range of the ESUs and DPSs continue to result in habitat degradation, reduction of spawning and rearing habitats, and reduction of stream flows. The result of these continuing land management practices in many locations has limited reproductive success, reduced rearing habitat quality and quantity, and caused migration barriers to both juveniles and adults. These factors likely limit the conservation value *(i.e.*, limiting the numbers of salmonids that can be supported) of designated critical habitat within freshwater habitats at the ESU/DPS scale.

Although watershed restoration activities have improved freshwater critical habitat conditions in isolated areas, reduced habitat complexity, poor water quality, and reduced habitat availability as a result of continuing land management practices continue to persist in many locations.

3. <u>Condition of Critical Habitat</u>

As part of the critical habitat designation process, NMFS convened Critical Habitat Analytical Review Teams (CHARTs) for steelhead and Chinook salmon. These CHARTs determined the conservation value of Hydrologic Subareas (HSAs) of watersheds under consideration. A CHART was not convened for coho salmon, because critical habitat had already been designated in 1999. NMFS determined the condition of coho salmon critical habitat based on other, readily available information.

a. *Condition of NC Steelhead Critical Habitat*

For NC steelhead, the CHART identified 50 occupied HSAs within the freshwater and estuarine range of the DPS. Nine HSAs were rated low in conservation value, 14 were rated medium, and 27 were rated high in conservation value (NMFS 2005). Within the DPS, the CHART ratings and economic benefits analysis resulted in designation of critical habitat with essential features for spawning, rearing and migration in approximately 3,148 miles of occupied stream habitat. NMFS believes the status of NC steelhead critical habitat in the 50 HSAs has not changed substantially since the 2005 assessment.

b. *Condition of CC Chinook Salmon Critical Habitat*

For CC Chinook salmon, the CHART identified 45 occupied HSAs within the freshwater and estuarine range of the ESU. Eight HSAs were rated low in conservation value, 14 were rated medium, and 27 were rated high in conservation value (NMFS 2005). Within the ESU, CHART ratings and economic benefits analysis resulted in the designation of critical habitat with essential features for spawning, rearing and migration in approximately 1634 miles of occupied habitat. NMFS believes the status of CC Chinook salmon critical habitat in the 45 HSAs has not changed substantially since the 2005 assessment.

c. *Condition of SONCC Coho Salmon Critical Habitat*

The condition of SONCC and CCC coho salmon critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that present depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: logging, agricultural and mining activities, urbanization, stream channelization, dams, wetland loss, and water withdrawals for irrigation. All of these factors were identified when SONCC and CCC coho salmon were listed as threatened under the ESA, and they all continue to affect this ESU. However, efforts to improve coho salmon critical habitat have been widespread and are expected to benefit the ESU. Within the SONCC recovery domain, from 2000 to 2006, the following improvements were completed: 242 stream miles have been treated, 31 stream miles of instream habitat were stabilized, 41 cubic feet per second of water has been returned for instream flow, and 1000s of acres of upland, riparian, and wetland habitat have been treated (NMFS 2007). Therefore, the condition of SONCC coho salmon critical habitat is likely improved or trending toward improvement compared to when it was designated in 1999.

V. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the status of the species, its habitat, and the ecosystem in the action area. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR § 402.02).

The action area includes all coastal anadromous California streams from Humboldt County at the Mendocino County border north to the Oregon border including Humboldt, Del Norte, Trinity and Siskiyou Counties. The area includes the following USGS 4th field HUCs: Upper Klamath, Lower Klamath, Shasta, Scott, Smith, Salmon, Trinity, South Fork Trinity, Mad-Redwood, Lower Eel, South Fork Eel, Middle Fork Eel, and Upper Eel. Urban development is found primarily on the estuaries of the larger streams, though there are some small towns and rural residences throughout the area. Forestry is the dominant land-use throughout the area, although there is some agriculture.

Native vegetation in the action area varies from old growth redwood (*Sequoia sempervirens*) forest along the lower drainages to Douglas-fir (*Pseudotsuga menziesii*) intermixed with hardwoods, to ponderosa pine (*Pinus ponderosa*) and Jeffery pine (*Pinus jefferyi*) stands along the upper elevations. Grasslands are located along the main ridge tops and south-facing slopes of the watersheds.

The action area has a Mediterranean climate characterized by cool, wet winters with typically high runoff; and dry, warm summers characterized by greatly reduced instream flows. Fog is a dominant climatic feature along the coast, generally occurring daily in the summer and not infrequently throughout the year. Higher elevations and inland areas tend to be relatively fog free. Most precipitation falls during the winter and early spring as rain, with occasional snow above 1,600 feet. The action area receives one of the highest annual amounts of rainfall in California, with a few sections averaging over 85 inches a year. Mean rainfall amounts ranges from 9 to 125 inches. Extreme rain events do occur, with over 240 inches recorded over parts of the action area during 1982/83. Along the coast, average air temperatures range from 46 °F to 56 °F. Farther inland and in the southern part of the action area, annual air temperatures are much more varied, ranging from below freezing in winter to over 100 °F during the summer months.

High seasonal rainfall on bedrock and other geologic units with relatively low permeability, erodible soils, and steep slopes contribute to the flashy nature (stream flows rise and fall quickly) of the watersheds within the action area. In addition, these high natural runoff rates have been increased by extensive road systems and other land uses. High seasonal rainfall combined with rapid runoff rates on unstable soils delivers large amounts of sediment to river systems. As a result, many river systems within the action area contain a relatively large sediment load, typically deposited throughout the lower gradient reaches of these systems.

A. Status of the Species in the Action Area

1. <u>Smith River</u>

There is a paucity of information with regard to salmon and steelhead populations in the Smith River and trend information is very limited. CDFG (1965) estimated escapement of Chinook salmon for Smith River drainage at approximately 15,000 fish annually. The best information regarding coho salmon abundance and trends was collected during Chinook salmon spawning surveys on an index reach of the West Branch of Mill Creek by Jim Waldvogel, Sea Grant Advisor for Del Norte County (NOAA Fisheries 2003b). The number of adult coho salmon trapped ranged from 2 (1981, 1990) to 28 (1985) fish annually, with a 23 year average of 11 adult coho salmon per year. No negative or positive trends are apparent from these data. Despite the lack of data, NOAA Fisheries suspects anadromous salmonid populations within the Smith River drainage have likely experienced declines similar to other northern California and southern Oregon coastal watersheds.

Current estimates of the abundance and distribution of the Smith River coho population are based on studies that have been conducted over the past several decades. These include a long-term data set describing salmon abundance in the West Branch and East Fork Mill Creek (McLeod and Howard 2010) since 1994. Within West Branch of Mill Creek, adult coho salmon spawner counts have ranged from a high of 175 to a low of 3 between 1994 and 2009 with decreases in numbers seen in more recent years (McLeod and Howard 2010).

Habitat conditions in the Smith River basin have been degraded by high timber harvest activities, mostly from redwood harvest on private lands in the coastal sections. Timber harvest in riparian areas has reduced the recruitment potential for LWD for decades or centuries (USFS 1995). Early logging, prior to more recent forest practice rules, removed much of the streamside vegetation, particularly along larger, more accessible channels. In many cases, regeneration within these areas is now dominated by hardwoods. Hardwood dominance has the dual effect of not providing adequately-sized wood to adjacent channels while suppressing conifer regeneration. The lack of conifer-derived woody debris is likely to persist and perhaps worsen as existing instream wood decays or is transported downstream and the adjacent stands are not capable of providing adequate replacements.

A legacy of mining roads and open pits and shafts that were used and operated in the 1850s to 1950s still exist in the North Fork Smith subbasin and in the Hardscrabble, Myrtle, Patrick, and Shelly watersheds. Many of these mining features are chronic sources of sediment since revegetation, and restoration is difficult due to the inherent harsh soil conditions of these areas. Hydraulic mining was intensive in low-gradient reaches of several tributaries, significantly altering stream channel characteristics and impacting fish habitat. Currently, the lower river is mined for aggregate material and is the primary aggregate source in Del Norte County. Removal of gravel has likely altered spawning habitat in some areas.

A widespread and aging road network continues to present a sediment hazard to channels in the Smith River basin. Additionally, hillslope landslides from timber harvest and other activities in the watershed (*e.g.*, mining) provide additional sediment. While some information suggests that the upper portions of the Smith River may be able to transport much of the sediment, lower gradient reaches may be vulnerable to the accumulation of this sediment. The Smith River basin is not currently listed as water quality impaired under section 303(d) of the CWA.

2. <u>Klamath and Trinity Rivers</u>

The Klamath River once supported diverse, abundant anadromous fish runs thought to number in the millions. Now, all of the anadromous fish species inhabiting the Klamath River are in a state of serious decline (Higgins et al. 1992), especially those species or stocks that depend on summer freshwater aquatic habitat, such as coho salmon, steelhead, or spring Chinook salmon.

In the Klamath River, poor water quality during the summer season is considered a major contributing factor to the decline of anadromous fish runs (Bartholow 1995). The main causative factors behind the poor water quality in the mainstem Klamath River are the large-scale water impoundment and diversion projects above Iron Gate Dam (Klamath River) and Lewiston Dam (Trinity River). Average annual runoff below Iron Gate Dam has declined by more than 370,000 acre-feet since inception of the Bureau of Reclamation's Klamath Project (National Research Council 2003), while up to 90 percent of the Trinity River flow has been annually diverted into the Sacramento River (Bureau of Land Management 1995). The large volume of water diverted from each of these basins significantly affects downstream flow levels and aquatic habitat. After analyzing both pre- and post-Klamath Project hydrologic records, Hecht and Kamman (1996) concluded that variability and timing of mean, minimum, and maximum flows changed significantly after construction of the project. Project operations tend to increase flows in October and November, and decrease flows in the late spring and summer as measured throughout the Klamath mainstem. Low summer flows within the Klamath River can increase daily maximum water temperatures by slowing flow transit rates and increasing thermal loading relative to higher flows (Deas and Orlob 1999). Moreover, further heating the already-warm, nutrient-rich water released from Iron Gate Dam typically results in poor water quality (*e.g.*, low dissolved oxygen, increased algal blooms) in the Klamath River between the dam and Seiad Valley.

Lower summer flows emanating from the Klamath Project (*i.e.*, released at Iron Gate Dam) are exacerbated by diminished inflow from many of the major tributaries to the middle Klamath River. The Shasta and Scott rivers historically supported strong populations of Chinook salmon, coho salmon, and summer-run steelhead (KRBFTF 1991). However, seasonal withdrawals for agriculture in the spring and summer months can drop stream flows by more than 100 cubic feet per second (cfs) over a 24 hour period, potentially stranding large numbers of rearing juvenile salmon and steelhead. Federal, State and local agencies are currently working with landowners in the Scott and Shasta drainages to implement minimum instream flow levels sufficient to conserve salmon and steelhead habitat.

The Klamath and Trinity rivers both contain numerous instream barriers that preclude salmon and steelhead migration into much of their historic range. Iron Gate Dam and Lewiston Dam block migratory access to the headwaters of the Klamath and Trinity rivers, respectively, while numerous smaller dams, diversions, and road crossings either block or impede adult and juvenile migration within many smaller tributaries.

Much of the middle reach of the Klamath River basin (*i.e.*, between the confluence of the Trinity River and Iron Gate Dam) and Trinity River basin is under Federal ownership and not managed for intensive timber harvest. However, the lower Klamath basin below the Trinity River confluence is largely under private ownership and categorized as industrial timberland. In general, surveys in this area indicate low amounts of LWD, and the size of LWD tends to be small, primarily one- to two-foot diameter pieces. Further, due to past logging practices and development along streams, many riparian zones tend to be dominated by alder, willow, and younger conifers (Simpson 2002). Given the current vegetation age structure and past logging history along streams, recruitment of adequately sized woody debris to many of the stream reaches is not likely to occur for several decades. Furthermore, hillslope erosion resulting from timber harvest and road building dominates many of the tributary subbasins of the lower Klamath basin. For example, harvesting over a 50-year period in Hunter Creek was estimated to be responsible for 51 percent of the observed shallow landsliding volume not attributed to road-related activities (Simpson 2002). Both the Klamath River (nutrients, organic enrichment/low dissolved oxygen, and temperature) and Trinity River (sedimentation/siltation) are listed under section 303(d) of the CWA as water quality limited (CSWRCB 2003).

3. Mad River and Redwood Creek

The Mad River and Redwood Creek watersheds have endured a long legacy of watershed disturbance. Streamside vegetation removal, channel modifications, and instream gravel extraction dating back many decades, combined with intensive upslope activities such as timber harvest and road construction, have had a significant influence on the condition of both watersheds. Furthermore, both the Mad River and Redwood Creek watersheds are section 303(d) listed for turbidity and sedimentation due to timber harvest, resource extraction, and nonpoint sources (CSWRCB 2003). A principal contributor of fine sediment is hydrologically connected road segments.

a. Mad River

Population growth rates for salmonids in the Mad River have not been quantified. The closest researchers have come to this goal is when Spence et al. (2007) described diver surveys which demonstrated the number of adult summer-run steelhead in three reaches of the Mad River declined at an average rate of 23 percent per year over two generations (from 1994 to 2002). The apparent decrease in population sizes of Mad River coho salmon, Chinook salmon, and steelhead indicates the populations are not replacing themselves.

The steelhead population in the Mad River watershed is at risk from adverse hatchery effects. NMFS specifically identified the past practices of the Mad River Hatchery as potentially damaging to NC steelhead. CDFG out-planted non-indigenous Mad River Hatchery brood stock to other streams within the DPS, and attempted to cultivate a run of non-indigenous summer-run steelhead within the Mad River. CDFG ended these practices in 1996. The current operation of the Mad River Hatchery has been identified as having potentially harmful effects to wild salmon populations as well.

Williams et al. (2008) determined at least 153 coho salmon spawners are needed each year in the Mad River population to avoid depensatory effects of extremely low population sizes. The most recent information indicates that adult coho salmon returns have declined to an average of 38 adults trapped and 16 females spawned at the Mad River hatchery between 1991 and 1999 (NMFS 2005). Only a fraction of all fish ascending the Mad River enter the Mad River fish ladder and fish hatchery, therefore counts there do not capture all spawners. However, the number of adult coho returns has been so low that the overall number of spawners is almost certainly a small fraction of the number required for viability. It is therefore likely that the Mad River coho salmon population is at high risk of detrimental population effects resulting from low population size.

Habitat surveys within the Mad River watershed detail the low amount and small size of existing LWD (primarily 1- to 2-foot diameter pieces). Further, due to past logging practices and development along streams, many riparian zones tend to be dominated by alder, willow, and younger conifers (Simpson 2002). Given the current vegetation age structure and past logging history along streams, recruitment of adequately-sized woody debris to many Mad River tributaries is not likely to occur for several decades.

b. Redwood Creek

Sparkman (2010) conducted outmigrant trapping in Redwood Creek the past 11 years using two traps, one located at river mile 33 and another located at river mile 4, just upstream of where Prairie Creek converges with the mainstem Redwood Creek. From 2000 to 2006, Sparkman (2006) did not capture any out-migrating coho salmon at the upper trap, suggesting that coho salmon spawning may have had limited success for about 7 years. However, in 2007, for the first time in eight consecutive years, six young-of-the-year (YOY) coho salmon were caught at the upper trap (Sparkman 2008a, 2008b). Low numbers of juvenile coho salmon were captured at the lower trap during all nine of the study years.

Using weir and spawner counts, estimated numbers of adult coho salmon in Prairie Creek in recent years indicate mostly low to occasionally moderate numbers of returning adult coho salmon (RNSP 2006). Williams et al. (2008) estimated that the historic annual spawner abundance was about 4,900 individuals. Numbers of live fish ranged from 660 in 2001/2002 to 41 in 2009/2010 (Duffy 2010). Although there may be higher numbers of spawners in the Prairie Creek watershed, all of the available information suggests that the overall number of coho salmon in the Redwood Creek basin is low relative to modeled historic abundance.

Estimates of the historical abundance of Redwood Creek Chinook salmon range from 1,000 (Wahle and Pearson 1987) to 5,000 individuals (Good et al. 2005). Redwood Creek Chinook salmon are declining precipitously, based on seine net counts during every summer between 1997 and 2006 (Anderson 2006). Duffy (2010) believes that Chinook salmon have declined in Prairie Creek during the past 6 to 7 years of monitoring, as they have gone from 400 adults to a total of about 15 over a spawning season.

CDFG has found that large numbers of 0+ steelhead emigrated from upper Redwood Creek, as evidenced by total annual trap catches ranging from 55,126 to 128,885 individuals over 6 years (Sparkman 2006). Sparkman (2006) described that between the years 2000 and 2006, there has been a negative trend in juvenile smolt production.

Logging, road building, and the construction and maintenance of flood control levees are the land uses that have had the most pronounced effect on coho salmon habitat in the Redwood Creek basin. Much of the upper and middle portions of the basin are owned by private timber companies and are used for timber production. In addition, livestock grazing occurs on some private lands, both in the middle and upper portions of the basin and in the valley bottom near Orick, where the grazing land is protected by flood control levees.

The Redwood Creek watershed, although naturally prone to extensive storm-induced erosional events, has also experienced accelerated erosion due to land management activities (RNSP 2002). Increased mass wasting and fluvial erosion have overwhelmed the stream channel's ability to efficiently move the delivered sediment, filling deep pools and depositing silt in spawning gravels used by salmonids. The Environmental Protection Agency (EPA 1998) estimates that on average, approximately 4,750 tons of sediment per square mile are produced from the Redwood Creek watershed. The EPA also estimated that 60 percent of this sediment is controllable (*i.e.*, discharges and depositions resulting from human activities that can influence water quality and can be reasonably controlled) and must be eliminated to meet instream targets. Much observed erosion is associated with an extensive road network (7.3 miles of road per square mile of land) on private lands, improperly designed and maintained roads and skid trails, and timber harvest. Accelerated erosion from land use practices and other causes are impacting the migration, spawning, reproduction, and early development of cold-water anadromous fish such as coho salmon, Chinook salmon, and steelhead.

4. <u>Eel River</u>

Fishery data indicate depressed or declining abundance trends, yet observational data indicate natural populations still persist in the Eel River, albeit at low levels. Historic land and water management, specifically large-scale timber extraction and water diversion projects, contributed to a loss of habitat diversity within the mainstem Eel River and many of its tributaries. The Eel River is listed under section 303(d) of the CWA as water quality limited due to excessive sediment and high water temperatures (CSWRCB 2003). Essential habitat feature limitations include high water temperatures, low instream cover levels, high sediment levels, and low LWD abundance.

Coho salmon are no longer present, or present in such low numbers that they have not been recently observed in most populations within the Eel River. The coho salmon populations in the Middle Fork Eel River and North Fork Eel River have likely been extirpated, while other populations (Upper Mainstem Eel, Middle Mainstem Eel, and Mainstem Eel River) are likely functionally extinct based upon a lack of detections, or extremely low numbers of individuals over a long period of time. The South Fork Eel River and Lower Eel River/Van Duzen populations of coho salmon are the only populations likely to have sufficient spawner densities to avoid depensatory effects of low population sizes.

Water diversion within the Eel River basin has occurred since the early 1900s at the Potter Valley facilities. Annually, about 160,000 acre-feet (219 cfs average) are diverted at Cape Horn Dam, through a screened diversion, to the Russian River basin. Flow releases from the Potter Valley facilities have both reduced the quantity of water in the mainstem Eel River, particularly during summer and fall low-flow periods, as well as dampened the within-year and between-year flow variability that is representative of unimpaired watersheds. These conditions have restricted juvenile salmonid rearing habitat, impeded migration of adult fish and late emigrating smolts, and provided ideal low-flow, warm water conditions for predatory Sacramento pikeminnow (*Ptychocheilus grandis*; NOAA Fisheries 2002).

Intensive timber extraction within the lower Eel and Van Duzen watersheds has caused chronic erosion in certain areas due to the highly erodible soils common throughout the two watersheds. An extensive study of sediment discharge within the Eel River watershed (Brown and Ritter 1971) determined that the suspended sediment discharge increases downstream, unlike most rivers. The average annual suspended sediment load is 10,000 tons per square mile (Brown and Ritter 1971), which is one of the highest measured sediment yields in the world. As discussed previously, high levels of suspended sediment can negatively affect salmonid populations by degrading essential freshwater habitat as well as reducing fitness of individual fish and modifying behavior.

The South Fork Eel River provides suitable habitat for Chinook salmon, coho salmon and steelhead. Existing conditions indicate that the South Fork Eel River has limited rearing habitat due to elevated water temperatures. Cool water seeps, thermal stratification, and habitat complexity all play critical roles in sustaining micro-habitat for juvenile and adult salmonids. Spawning habitat is present and actively used, as indicated by redd observations in the Cooks Valley area. Fishery data indicate that individual natural populations of anadromous salmonids persist at low levels in the South Fork Eel River.

The Van Duzen River watershed reflects a long legacy of upstream and upslope impacts coupled with the effects of continued instream disturbances. Much of the available salmonid habitat within the Van Duzen watershed is currently degraded by high levels of sediment, low pool density, high water temperatures, and low instream cover levels. The Van Duzen River is listed under section 303(d) of the CWA as water quality limited due to excessive sediment (CSWRCB 2003).

5. <u>Mattole River</u>

Surveys of live fish and carcasses since 1994 indicate the coho salmon population is severely depressed and well below the modeled depensation threshold of 250 spawners. Recent spawner surveys in the Mattole River resulted in only 3 and 9 coho salmon for 2009 and 2010, respectively. It is likely that the Mattole River has extremely low numbers in some brood year classes or perhaps some may have been extirpated altogether. Given the small numbers of adults returning, the Mattole River population is approaching functional extirpation. These low numbers, along with a recent decline since 2005, indicate that the Mattole River coho salmon population is at a high risk of extinction.

Although several factors have contributed to the decline of anadromous salmonid populations in the Mattole River drainage, habitat loss and modification are major determinants of their current status (FEMAT 1993). Large-scale changes to the Mattole River occurred in response to the 1955 and 1964 floods, which coincided with peak years of logging and road building in the basin. The Mattole watershed has the second highest estimated erosion rate in northern California, second only to the Eel River (Griggs and Hein 1980), and is highly sensitive to human-induced disturbances within upper reaches of the watershed.

Logging practices in the Mattole River watershed were identified as the "specific critical habitat problem" in a status review by Myers et al. (1998). There were an estimated 3,310 miles of active and abandoned roads in the Mattole River watershed (Perala et al. 1993), and the combined effects of these roads may be the single largest source of fine sediment delivered to the Mattole River. Estuary habitat, a crucial link in the lifecycle of Pacific salmonids, has been reduced by excessive sedimentation, which has also resulted in higher water temperatures and adverse impacts to food resources. Likewise, elevated summer water temperatures within the mainstem as well as many tributaries are also a primary limiting factor for salmonids rearing in the Mattole River. The Mattole River is listed under section 303(d) of the CWA as water quality limited due to temperature, turbidity, and sedimentation (CSWRCB 2003).

VI. EFFECTS OF THE PROPOSED ACTION

Of the proposed restoration project types, several are expected to have only beneficial effects to listed species. Many of the water conservation projects occur beyond a diversion point (barrier to fish), not interacting with fish or their habitat and provide benefits by increasing instream water availability. Riparian habitat restoration actions occur outside of the wetted channel having only wholly beneficial effects to fish and their habitat. The following components of the proposed action will not be considered in the following analysis due to their expected insignificant, discountable, or wholly beneficial effects: riparian habitat restoration, development of alternative stockwater supply, tailwater collection ponds, water storage tanks, and piping ditches.

A. Insignificant or Discountable Effects to Listed Species or Their Critical Habitat

The remaining seven proposed project types may adversely affect listed species; however, some components of the projects also may result in effects, such as habitat disturbance from heavy equipment operation, riparian vegetation disturbance, chemical contamination, and reduced benthic macroinvertebrate production that are not likely to adversely affect listed species or their critical habitats. These effects are expected to be insignificant or discountable as explained further below.

1. <u>Noise, Motion, and Vibration Disturbance from Heavy Equipment Operation</u>

Noise, motion, and vibration produced by heavy equipment operation is expected at most instream restoration sites. However, the use of equipment, which will occur primarily outside the active channel, and the infrequent, short-term use of heavy equipment in the wetted channel to construct cofferdams, is expected to result in insignificant adverse effects to listed fishes. Listed salmonids will be able to avoid interaction with instream machinery by temporarily relocating either upstream or downstream into suitable habitat adjacent to the worksite. In addition, the minimum distance between instream project sites and the maximum number of instream projects under the proposed Program would further reduce the potential aggregated effects of heavy equipment disturbance on listed salmonids

2.. <u>Disturbance to Riparian Vegetation</u>

Most proposed fisheries restoration actions are expected to avoid disturbing riparian vegetation through the proposed avoidance and minimization measures. In general, the restorative nature of these projects is to improve habitat conditions for salmonids, and thus, riparian vegetation disturbance is expected to be avoided, as practicable. However, there may be limited situations where avoidance is not possible.

In the event that streamside riparian vegetation is removed, the loss of riparian vegetation is expected to be small, due to minimization measures, and limited to mostly shrubs and an occasional tree. Most riparian vegetation impacts are expected to be typical riparian species such as willows and other shrubs, which are generally easier to recover or reestablish. In addition, the revegetation of disturbed riparian areas is expected to further minimize the loss of vegetation. Therefore, NMFS anticipates only an insignificant loss of riparian habitat and function within the action area to result from the proposed restoration activities.

3. <u>Chemical Contamination from Equipment Fluids</u>

Equipment refueling, fluid leakage, and maintenance activities within and near the stream channel pose some risk of contamination and potential take. In addition to toxic chemicals associated with construction equipment, water that comes into contact with wet cement during construction of a restoration project can also adversely affect water quality and may harm listed salmonids. However, all fisheries restoration projects will include the measures outlined in the sections entitled, *Measures to Minimize Disturbance From Instream Construction* and *Measures to Minimize Degradation of Water Quality* within Part IX of the Restoration Manual, which address and minimize pollution risk from equipment operation. Therefore, water quality degradation from toxic chemicals associated with the habitat restoration projects is discountable.

4. <u>Reduced Benthic Macroinvertebrate Community</u>

Benthic (*i.e.*, bottom dwelling) aquatic macroinvertebrates may be temporarily lost or their abundance reduced when stream habitat is dewatered (Cushman 1985). Effects to aquatic macroinvertebrates resulting from stream flow diversions and dewatering will be temporary because instream construction activities occur only during the low flow season, and rapid recolonization (about one to two months) of disturbed areas by macroinvertebrates are expected following rewatering (Cushman 1985, Thomas 1985, Harvey 1986). In addition, the effect of macroinvertebrate loss on juvenile coho salmon, Chinook salmon, or steelhead is likely to be negligible because food from upstream sources (via drift) would be available downstream of the dewatered areas since stream flows will be maintained around the project work site. Based on the foregoing, the loss of aquatic macroinvertebrates resulting from dewatering activities is not likely to adversely affect coho salmon, Chinook salmon, or steelhead.

B. Adverse Effects to Listed Species

In this section we identify the direct and indirect adverse effects of the proposed action on the listed species, their designated critical habitat, or both. The species and designated critical habitat that may be exposed and the anticipated responses will vary depending on the location of each individual habitat restoration project site. For example, some sites may occur in rivers and streams that have all three listed salmonids, while other sites may be located in streams where only one listed species is present.

Individual restoration projects authorized through the 10-year Program that require instream activities will be implemented during low flow periods between June 15 and November 1. The specific timing and duration of each individual restoration project will vary depending on the project type, specific project methods, and site conditions. However, the duration and magnitude of effects to listed salmonids and to salmonid critical habitat associated with implementation of individual restoration projects will be significantly minimized due to the multiple proposed avoidance and minimization measures.

Implementing individual restoration projects during the summer low-flow period will avoid emigrating coho salmon, Chinook salmon, and steelhead smolts and will minimize exposure to immigrating Chinook salmon and coho salmon adults at all habitat restoration project sites. The total number of projects and the location of individual projects authorized through the Program annually will vary from year to year depending on various factors, including funding and scheduling. If the rates of funding and project implementation remains consistent with the rates of the past several years, the total number of projects expected to be implemented each year should range between 15 and 30, however significant restoration efforts are predicted to occur in the Klamath Basin which could double the estimated number of projects (Bob Pagliuco, NOAA RC pers. comm. May 2011).

Except for riparian habitat restoration and streamflow augmentation, all proposed restoration types are expected to result in adverse effects to listed species. Despite the different scope, size, intensity, and location of these proposed restoration actions, the potential adverse effects to listed salmonids all result from dewatering, fish relocation, and increased sediment. Dewatering, fish relocation, and structural placement will result in direct effects to listed salmonids, where a small percentage of individuals are expected to be injured or killed. The effects from increased sediment mobilization into streams are usually indirect effects, where the effects to habitat, individuals, or both, are reasonably certain to occur and are later in time.

1. Dewatering

Although all project types include the possibility of dewatering, not all individual project sites will need to be dewatered. Based on personal communication with Bob Pagliuco of the NOAA RC (May 2011), an estimated 3 of 85 projects occurring between 2008 and 2011 (as of May 17, 2011) required dewatering. When dewatering is necessary, only a small reach of stream at each project site will be dewatered for instream construction activities. Dewatering encompasses placing temporary barriers, such as a cofferdam, to hydrologically isolate the work area, re-routing stream flow around the dewatered area, pumping water out of the isolated work area, relocating fish from the work area (discussed separately), and restoring the project site upon project completion. The length of contiguous stream reach that will be dewatered for most projects is expected to be less than 500 feet and no greater than 1000 feet for any one project site.

a. Exposure

Because the proposed dewatering would occur during the low flow period, the species and life stages most likely to be exposed to potential effects of dewatering are juvenile coho salmon and juvenile steelhead. Most juvenile Chinook salmon would be avoided since the timing of the instream activities occur after they have migrated to the ocean. A few juvenile Chinook salmon, especially with a stream-type life history strategy, as well as adult summer run steelhead and half-pounder steelhead, may also be exposed where these individuals are present at or near the proposed project sites, although past relocation results indicated the chances of encountering these species and life stages is very low (Flosi 2010). Dewatering is expected to occur mostly during the first half of the instream construction window (*e.g.*, to accommodate for the necessary construction time needed), and therefore should avoid exposure to adult Chinook salmon and adult coho salmon. Dewatering that occurs in the latter half of the instream construction window or in the range of summer run steelhead or half pounders, may expose adult Chinook salmon, early incoming coho salmon, summer steelhead, and half pounders to displacement (table 4). However, adult salmonids and half-pounders are not likely to be exposed because adults will avoid the construction area and dewatering is very rarely done so late in the low flow season.

b. Response

The effects of dewatering result from the placement of the temporary barriers, the trapping of individuals in the isolated area, and the diversion of streamflow. Fish relocation and ground disturbance effects are discussed further in sections 2 through 4 below. Rearing juvenile coho salmon, steelhead, and to a much lesser extent, juvenile stream-type Chinook salmon could be killed or injured if crushed during placement of the temporary barriers, such as cofferdams, though crushing is expected to be minimal due to evasiveness of most juveniles. Stream flow diversions could harm salmonids by concentrating or stranding them in residual wetted areas (Cushman 1985) before they are relocated, or causing them to move to adjacent areas of poor habitat (Clothier 1953, Clothier 1954, Kraft 1972, Campbell and Scott 1984). Salmonids, especially juveniles since they are not as visible as adults, that are not caught during the relocation efforts would be killed from either construction activities or desiccation.

Changes in flow are anticipated to occur within and downstream of project sites during dewatering activities. These fluctuations in flow, outside of dewatered areas, are anticipated to be small, gradual, and short-term, which should not result in any harm to salmonids. Stream flow in the vicinity of each project site should be the same as free-flowing conditions, except during dewatering and in the dewatered reach where stream flow is bypassed. Stream flow diversion and project work area dewatering are expected to cause temporary loss, alteration, and reduction of aquatic habitat.

Dewatering may result in the temporary loss of rearing habitat for juvenile salmonids. The extent of temporary loss of juvenile rearing habitat should be minimal because habitat at the restoration sites is typically degraded and the dewatered reaches are expected to be less than 500 feet per site and no more than a total of 1000 feet per project. These sites will be restored prior to project completion, and should be enhanced by the restoration project.

Effects associated with dewatering activities will be minimized due to the multiple minimization measures that will be utilized as described in the section entitled, *Measures to Minimize Impacts to Aquatic Habitat and Species During Dewatering of Projects* within Part IX of the Restoration Manual. Juvenile coho salmon, steelhead and stream-type Chinook salmon that avoid capture in the project work area will die during dewatering activities. NMFS expects that the number of coho salmon, Chinook salmon, or steelhead that will be killed as a result of barrier placement and stranding during site dewatering activities is very low, likely less than one percent of the total number of salmonids in the project area. The low number of juveniles expected to be injured or killed as a result of dewatering is based on the low percentage of projects that require dewatering (*i.e.*, generally only up to 4 percent), the avoidance behavior of juveniles to disturbance, the small area affected during dewatering at each site, the low number of juveniles in the typically degraded habitat conditions common to proposed restoration sites, and the low numbers of juvenile salmonids expected to be present within each project site after relocation activities. Table 4 summarizes the dewatering effects to salmonids.

Table 4. Summary of effects to individual listed species from dewatering.

Action	Life Stage	Species	Anticipated Exposure	Response
Temporary barrier placement	Juvenile	NC Steelhead SONCC Coho CC Chinook Salmon	Low Low Rare	Injury or death from being crushed
Dewatering	Juvenile	NC Steelhead SONCC Coho CC Chinook Salmon	Low Low Rare	Desiccation (Death)

2. <u>Fish Relocation Activities</u>

All project sites that require dewatering will include fish relocation. CDFG personnel (or designated agents) capture and relocate fish (and amphibians) away from the restoration project work site to minimize adverse effects of dewatering to listed salmonids. Fish in the immediate project area will be captured by seine, dip net and/or by electrofishing, and will then be transported and released to a suitable instream location.

a. Exposure

Because fish relocation is required when dewatering, the species and life stages most likely to be exposed to fish relocation are juvenile coho salmon and steelhead. Most juvenile Chinook salmon will not be exposed since the timing of instream activities occur after they have emigrated from streams. However, a few juvenile Chinook salmon, especially those with a stream-type life history strategy, may also be exposed where these individuals are stranded within the dewatering area (table 4).

b. Response

Fish relocation activities may injure or kill rearing juvenile coho salmon and steelhead because these individuals are most likely to be present in the project sites. Any fish collecting gear, whether passive or active (Hayes 1983) has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of injury and mortality attributable to fish capture varies widely depending on the method used, the ambient conditions, and the expertise and experience of the field crew. The effects of seining and dip-netting on juvenile salmonids include stress, scale loss, physical damage, suffocation, and desiccation. Electrofishing can kill juvenile salmonids, and researchers have found serious sublethal effects including spinal injuries (Reynolds 1983, Habera et al. 1996, Habera et al. 1999, Nielsen 1998, Nordwall 1999). The long-term effects of electrofishing on salmonids are not well understood. Although chronic effects may occur, most effects from electrofishing occur at the time of capture and handling.

Most of the stress and death from handling result from differences in water temperature between the stream and the temporary holding containers, dissolved oxygen levels, the amount of time that fish are held out of the water, and physical injury. Handling-related stress increases rapidly if water temperature exceeds 18 °C or dissolved oxygen is below saturation. A qualified fisheries biologist will relocate fish, following both CDFG and NMFS electrofishing guidelines. Because of these measures, direct effects to, and mortality of, juvenile coho salmon and steelhead during capture will be greatly minimized.

Although sites selected for relocating fish will likely have similar water temperature as the capture site and should have ample habitat, in some instances relocated fish may endure short-term stress from crowding at the relocation sites. Relocated fish may also have to compete with other salmonids, which can increase competition for available resources such as food and habitat. Some of the fish at the relocation sites may choose not to remain in these areas and may move either upstream or downstream to areas that have more habitat and lower fish densities. As each fish moves, competition remains either localized to a small area or quickly diminishes as fish disperse.

Fish relocation activities are expected to minimize individual project impacts to juvenile coho salmon and steelhead by removing them from restoration project sites where they would have experienced high rates of injury and mortality. Fish relocation activities are anticipated to only affect a small number of rearing juvenile coho salmon and/or steelhead within a small stream reach at and near the restoration project site and relocation release site(s). Rearing juvenile coho salmon and/or steelhead present in the immediate project work area will be subject to disturbance, capture, relocation, and related short-term effects. Most of the take associated with fish relocation is anticipated to be non-lethal, however, a very low number of rearing juvenile (mostly YOY) coho salmon and/or steelhead captured may become injured or die. In addition, the number of fish affected by increased competition is not expected to be significant at most fish relocation sites, based upon the suspected low number of relocated fish inhabiting the small project areas.

Effects associated with fish relocation activities will be significantly minimized due to the multiple minimization measures that will be utilized, as described in the section entitled, *Measures to Minimize Injury and Mortality of Fish and Amphibian Species During Dewatering* within Part IX of the Restoration Manual. NMFS expects that fish relocation activities associated with implementation of individual restoration projects will not significantly reduce the number of returning listed salmonid adults. Fish relocation activities will occur during the summer low-flow period after emigrating smolts have left the restoration project sites and before adult fish travel upstream. Therefore, the majority of listed salmonids that will be captured during relocation activities will be age-0 coho and juvenile steelhead parr of various ages. Although most mortalities of coho salmon and/or steelhead during fish relocation activities will occur almost exclusively at the YOY stage, there is a potential of unintentional mortality of a one- or two-year old fish.

Based on the CDFG FRGP annual monitoring reports (Collins 2004, 2005; CDFG 2006, 2007, 2008, 2009, 2010), NMFS is able to estimate the maximum number of federally listed salmonids expected to be captured, injured, and killed each year from the dewatering and relocation activities (table 5). When comparing the past 4 years of NOAA RC-funded projects, only about three were dewatered and required relocation of listed species (Pagliuco, pers. comm. 2011). The CDFG monitoring reports show that the FRGP program dewaters approximately 12 percent of their funded projects (Table 5). When estimating the maximum number of listed salmonids that are expected to be captured each year, NMFS used the CDFG FRGP monitoring reports, reducing the highest number of captured individuals by a factor of 4 to account for the lower number of projects expected to be dewatered under the proposed program (Table 6). NMFS used the highest percentage recorded under the FRGP program to estimate the percent of each species that would be injured or killed each year (Table 6). As a result, NMFS expects that (1) no more than 766 juvenile SONCC coho salmon will be captured, 0.6 percent of the captured coho salmon will be injured, and 0.6 percent of the captured coho salmon will be killed annually; (2) no more than 1,502 juvenile NC steelhead will be captured, 0.7 percent of the captured steelhead will be injured, and 0.6 percent of the captured steelhead will be killed annually; and (3) no more than 5 juvenile CC Chinook salmon will be captured, and one of those captured will be injured or killed (Table 6).

Table 5. Dewatering and relocation information for CDFG FRGP Program.

Species	Year	# Projects in Humboldt County	# Projects Dewatered	# Captured	# Injured	% Injured	# Killed	% Killed
Coho	2002	21	3	0	-	-	-	-
Coho	2003	42	8	8	-	-	0	0.00
Coho	2004	123	10	0	-	-	-	-
Coho	2005	158	17	344	2	0.58	2	0.58
Coho	2006	137	18	185	1	0.54	0	0.00
Coho	2007	147	14	253	0	0.00	11	4.35
Coho	2008	119	15	3064	0	0.00	0	0.00
Coho	2009	110	6	18	0	0.00	0	0.00
Coho	2010	87	8	3	0	0.00	0	0.00
Highest number and percent for coho salmon				**3064**		**0.58**		**0.58***
*The highest data point (4.35%) was excluded as an outlier								
Steelhead	2002	21	3	1539	-	-	5	0.32
Steelhead	2003	42	8	2361	-	-	7	0.30
Steelhead	2004	123	10	2306	2	0.09	2	0.09
Steelhead	2005	158	17	618	2	0.32	2	0.32
Steelhead	2006	137	18	2255	16	0.71	6	0.27
Steelhead	2007	147	14	3732	10	0.27	21	0.56
Steelhead	2008	119	15	6007	12	0.20	32	0.53
Steelhead	2009	110	6	2186	7	0.32	7	0.32
Steelhead	2010	87	8	633	3	0.47	3	0.47
Highest number and percent for steelhead				**6007**		**0.71**		**0.56**
Chinook	2008	119	15	18	0	0.00	0	0.00

Highest number and percent for Chinook salmon	**18**		**0**		**0**

Table 6. Estimated maximum number of salmonids that will be captured, injured, or killed under the proposed program.

Species	Max. # Individuals Captured/Yr*	Max. % Injured/Yr	Max. # Individuals Injured/Yr	Max. % Killed/Yr	Max. # Individuals Killed/Yr
Coho	766	0.6	5	0.6**	5
Steelhead	1502	0.7	11	0.6	9
Chinook	5	-	1***	-	1***

*Maximum number of individuals captured per year calculated from highest data point in table 5 and divided by four to account for lower rate of dewatered projects
**The highest data point (4.35%) in table 5 was excluded as an outlier
***Because the previous data (table 5) resulted in 0% injured or killed, NMFS will conservatively expect one or less individual injured or killed per year.

3. Structural Placement

Most of the proposed restoration project types include the potential for placement of structures in the stream channel. These structural placements can vary in their size and extent, depending on their restoration objective. Most structural placements are discrete where only a localized area will be affected. The salmonids exposed to such structural placements are the same juvenile species that would be exposed to dewatering effects. Where structural placements are small and discrete, salmonids are expected to avoid the active construction area and thus will not be crushed. When structural placements are large or cover a large area, such as gravel augmentation, some juvenile salmonids may be injured or killed. However, the number of juveniles injured or killed is expected to be no more than the number of individuals that will be killed by desiccation after the reach is dewatered without such structural placement. Fish relocation is expected to remove most salmonids. In essence, juvenile fish that are not relocated will be killed by either dewatering or structural placement.

4. Increased Mobilization of Sediment within the Stream Channel

The proposed restoration project types involve various degrees of earth disturbance. Inherent with earth disturbance is the potential to increase background suspended sediment loads for a short period during and following project completion.

All project types involving ground disturbance in or adjacent to streams are expected to increase turbidity and suspended sediment levels within the project work site and downstream areas. Therefore, instream habitat improvement, instream barrier modification for fish passage improvement, stream bank stabilization, fish passage improvements at stream crossings, small dam removal[4], creation of off channel/side channel habitat, and upslope watershed restoration,[5]

4 Because of the sideboards and engineering requirements described in the proposed action, small dam removal is

and fish screen construction may result in increased mobilization of sediment into streams. Although riparian restoration may involve ground disturbance adjacent to streams, the magnitude and intensity of this ground disturbance is expected to be small and isolated to the riparian area. Fish screen projects are not expected to release appreciable sediment into the aquatic environment.

a. Exposure

In general, sediment-related effects are expected during the summer construction season (June 15 to November 1), as well as during peak-flow winter storm events when remaining loose sediment is mobilized. During summer construction, the species and life stages most likely to be exposed to potential effects of increased sediment mobilization are juvenile coho salmon and juvenile steelhead. As loose sediment is mobilized by higher winter flows, adult Chinook salmon, coho salmon, and steelhead may also be exposed to increased turbidity. Removal of small dams and road crossing projects will have the greatest potential for releasing excess sediment. However, minimization measures, such as removing excess sediment from the dewatered channel prior to returning flow will limit the amount of sediment released. The increased mobilization of sediment is not likely to degrade spawning gravel because project related sediment mobilization should be minimal due to the use of sideboards and minimization measures. This small amount of sediment is expected to affect only a short distance downstream, and should be easily displaced by either higher fall/winter flows or redd building. In the winter, the high flows will carry excess fine sediment downstream to point bars and areas with slower water velocities. Because redds are built where water velocities are higher, the minimally increased sediment mobilization is not expected to smother existing redds. Therefore, salmonid eggs and alevin are not expected to be exposed to the negligible increase in sediment on redds. Since most restoration activities will focus on improving areas of poor instream habitat, NMFS expects the

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expected to have similar sediment mobilization effects as culvert replacement or removal

[5] Although road restoration projects may entail culvert replacement or removal, the resulting sediment effect is expected to be significantly smaller when compared to a typical fish passage improvement project. Road restoration projects typically deal with upslope road networks located high within the watershed drainage network. As a result, typical road crossings in these upslope areas largely occur in higher gradient, first or second order stream channels and feature small (*e.g.,* less than 4-foot diameter) culverts. In contrast, fish passage projects funded through the Program typically focus limited restoration funding on high-priority fish passage issues located on third or fourth order stream networks that, when completed, will re-establish fish access to large expanses of upstream habitat. In effect, both the size and gradient of upslope channels and culverts largely limit downstream sediment impacts during road decommissioning projects. Small, high gradient stream channels typically transport sediment downstream more efficiently (and therefore store less upstream of the culvert) than lower gradient, higher order stream reaches where flow and channel morphology favor sediment deposition. Furthermore, the comparative size of these upslope road culverts (16-48 inch diameter) likely limit the volume of any sediment wedge that can develop upstream of the structure. Because of these unique characteristics common to culverts typically found on upslope roads, NMFS anticipates individual culvert projects that are part of a larger road decommissioning project will not approach an effect level similar to larger fish passage projects, and thus are not considered when computing maximum project density per watershed (as detailed in the section titled "Sideboards, Minimization Measures, and other Requirements" within the Proposed Action).

number of fish inhabiting individual project areas during these periods of increased sediment input, and thus directly affected by construction activities, to be relatively small.

b. Response

Restoration activities may cause temporary increases in turbidity and deposition of excess sediment may alter channel dynamics and stability (Habersack and Nachtnebel 1995, Hilderbrand et al. 1997, Powell 1997, Hilderbrand et al. 1998). Erosion and runoff during precipitation and snowmelt will increase the supply of sediment to streams. Heavy equipment operation in upland and riparian areas increases soil compaction, which can increase runoff during precipitation. High runoff can then, in turn, increase the frequency and duration of high stream flows in construction areas. Higher stream flows increase stream energy that can scour stream bottoms and transport greater sediment loads farther downstream than would otherwise occur.

Sediment may affect fish by a variety of mechanisms. High concentrations of suspended sediment can disrupt normal feeding behavior (Berg and Northcote 1985), reduce growth rates (Crouse et al. 1981), and increase plasma cortisol levels (Servizi and Martens 1992). Increased sediment deposition can fill pools and reduce the amount of cover available to fish, decreasing the survival of juveniles (Alexander and Hansen 1986) and holding habitat for adults. Excessive fine sediment can interfere with development and emergence of salmonids (Chapman 1988). Upland erosion and sediment delivery can increase substrate embeddedness. These factors make it harder for fish to excavate redds, and decreases redd aeration (Cederholm et al. 1997). High levels of fine sediment in streambeds can also reduce the abundance of food for juvenile salmonids (Cordone and Kelly 1961, Bjornn et al. 1977).

Short-term increases in turbidity are anticipated to occur during dewatering activities and/or during construction of a coffer dam. Research with salmonids has shown that high turbidity concentrations can: reduce feeding efficiency, decrease food availability, reduce dissolved oxygen in the water column, result in reduced respiratory functions, reduce tolerance to diseases, and can also cause fish mortality (Berg and Northcote 1985, Gregory and Northcote 1993, Velagic 1995, Waters 1995). Mortality of very young coho salmon and steelhead fry can result from increased turbidity (Sigler et al. 1984). Even small pulses of turbid water will cause salmonids to disperse from established territories (Waters 1995), which can displace fish into less suitable habitat and/or increase competition and predation, decreasing chances of survival. Nevertheless, much of the research mentioned above focused on turbidity levels significantly higher than those likely to result from the proposed restoration activities, especially with implementation of the proposed avoidance and minimization measures.

Yet, research investigating the effects of sediment concentration on fish density has routinely focused on high sediment levels. For example, Alexander and Hansen (1986) measured a 50 percent reduction in brook trout (*Salvelinus fontinalis*) density in a Michigan stream after manually increasing the sand sediment load by a factor of four. In a similar study, Bjornn et al.

(1977) observed that salmonid density in an Idaho stream declined faster than available pool volume after the addition of 34.5 m^3 of fine sediment into a 165 m study section. Both studies attributed reduced fish densities to a loss of rearing habitat caused by increased sediment deposition. However, streams subject to infrequent episodes adding small volumes of sediment to the channel may not experience dramatic morphological changes (Rogers 2000). Similarly, research investigating severe physiological stress or death resulting from suspended sediment exposure has also focused on concentrations much higher than those typically found in streams subjected to minor/moderate sediment input (reviewed by Newcombe and MacDonald (1991) and Bozek and Young (1994)).

In contrast, the lower concentrations of sediment and turbidity expected from the proposed restoration activities are unlikely to be severe enough to cause injury or death of listed juvenile coho salmon and/or steelhead. Instead, the anticipated low levels of turbidity and suspended sediment resulting from instream restoration projects will likely result in only temporary behavioral effects. Recent monitoring of newly replaced culverts[6] within the action area detailed a range in turbidity changes downstream of newly replaced culverts following winter storm events (Humboldt County 2002, 2003 and 2004). During the first winter following construction, turbidity rates (NTU) downstream of newly replaced culverts increased an average of 19 percent when compared to measurements directly above the culvert. However, the range of increases within the 11 monitored culverts was large (n=11; range 123% to -21%). Monitoring results from one- and two-year-old culverts were much less variable (n=11; range:12% to -9%), with an average increase in downstream turbidity of one percent. Although the culvert monitoring results show decreasing sediment effects as projects age from year one to year three, a more important consideration is that most measurements fell within levels that were likely to only cause slight behavioral changes [*e.g.*, increased gill flaring (Berg and Northcote 1985), elevated cough frequency (Servizi and Marten 1992), and avoidance behavior (Sigler et al. 1984)]. Turbidity levels necessary to impair feeding are likely in the 100 to 150 NTU range (Gregory and Northcote 2003, Harvey and White 2008). However, only one of the Humboldt County measurements exceeded 100 NTU (NF Anker Creek, year one), whereas the majority (81 percent) of downstream readings were less than 20 NTU. Importantly, proposed minimization measures, some of which were not included in the culvert work analyzed above, will likely ensure that future sediment effects from fish passage projects will be less than those discussed above. Therefore, the small pulses of moderately turbid water expected from the proposed instream restoration projects will likely cause only minor physiological and behavioral effects, such as dispersing salmonids from established territories, potentially increasing interspecific and intraspecific competition, as well as predation risk for the small number of affected fish.

Upslope watershed restoration activities, such as road decommissioning and upgrading, are

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6 When compared to other instream restoration projects (*e.g.*, bank stabilization, instream structure placement), culvert replacement/upgrade projects typically entail a higher degree of instream construction and excavation, and by extension greater sediment effects. Thus, we have chosen to focus on culvert projects as a "worst case" scenario when analyzing potential sediment effects from instream projects.

expected to mobilize sediment through ripping and recontouring. However, these activities are generally higher up in the watersheds where the adjacent streams are typically first or second order, and are typically not fish bearing. Sediment mobilization will be minimized through road outsloping, reseeding and mulching disturbed areas, and other erosion control measures. These erosion control measures should prevent a majority of the sediment from reaching fish bearing streams. In addition, road projects funded by the NOAA RC indicate that the subject roads already pose sediment problems for salmonids, and are in need of upgrading, repair, or decommissioning. Therefore, upslope road work (*e.g.,* road decommissioning), when implemented with the proposed erosion control measures, may result in about the same volume of sediment introduced into streams prior to road work in the short term.

Upslope restoration activities, in the long term, should result in reduced sediment volume than unimproved roads. Road upgrading and decommissioning activities have been documented to reduce road-related erosion (Madej 2001, Switalski et al. 2004, McCaffery et al. 2007) and landslide risk (Switalski et al. 2004). Road decommissioning studies in the Redwood Creek watershed, Humboldt County, have found that treated roads, on average, contributed only 25% of the sediment volume produced from untreated roads (Madej 2001). Vegetation, in particular, when reestablished on decommissioned roads, leads to reduced fine sediment in adjacent streams (McCaffery et al. 2007). The amount of fine sediment mobilized from highly revegetated decommissioned roads can be at levels that existed prior to the road construction (McCaffery et al. 2007).

NMFS does not expect sediment effects to accumulate at downstream restoration sites within a given watershed. Sediment effects generated by each individual project will likely impact only the immediate footprint of the project site and up to approximately 1500 feet of channel downstream of the site. Studies of sediment effects from culvert construction determined that the level of sediment accumulation within the streambed returned to control levels between 358 to 1,442 meters downstream of the culvert (LaChance et al. 2008). Because of the multiple measures to minimize sediment mobilization, described in the Restoration Manual under *Measures to Minimize Degradation of Water Quality,* on pages IX-50 and IX-51, downstream sediment effects from the proposed restoration projects are expected to extend downstream for a distance consistent with the range presented by LaChance et al. (2008). The proposed 800-foot buffer between instream projects is likely large enough to preclude sediment effects from accumulating at downstream project sites. Furthermore, the temporal and spatial scale at which project activities are expected to occur will also likely preclude significant additive sediment related effects. Assuming projects will continue to be funded and implemented similar to the past several years, NMFS expects that individual restoration projects sites will occur over a broad spatial scale each year. In other words, restoration projects occurring in close proximity to other projects during a given restoration season is unlikely, thus diminishing the chance that project effects would combine. Finally, effects to instream habitat and fish are expected to be short-term, since most project-related sediment will likely mobilize during the initial high-flow event the following winter season. Subsequent sediment mobilization may occur following the next two winter seasons, but generally should subside to baseline conditions by the third year as found in other studies, such as Klein et al. (2006), and suggested by the Humboldt County data (Humboldt County 2004).

C. Effects to Critical Habitat

1. Adverse Effects to PCEs

The critical habitat designation for salmonid species includes several Primary Constituent Elements (PCEs) which will be affected under the proposed action. These PCEs include spawning, rearing, and migration habitats.

Juvenile rearing sites require cover and cool water temperatures during the summer low flow period. Over-wintering juvenile salmonids require refugia to escape to during high flows in the winter. Adverse effects to rearing habitat will primarily occur as a result of dewatering the channel and increasing sediment input during instream activities. Loss of rearing sites can occur through dewatering habitat and the filling of pools with fine sediment. However, these adverse effects are expected to be temporary and of short duration. The activities described in the proposed action will increase quality of rearing habitat over the long term. Rearing habitat will be improved by adding complexity that will increase pool formation, cover structures, and velocity refugia.

As explained above, spawning habitat is not likely to be adversely affected by the temporary increase in fine sediment resulting from proposed activities. Spawning habitat is located where water velocities are higher, where mobilized fine sediment is less likely to settle. Where limited settling does occur in spawning habitat, the minimally increased sediment is not expected to degrade spawning habitat due to the small amounts and short term nature of the effects. Activities described in the proposed action will improve the quality of spawning habitat over the long term. Spawning habitat will be improved by reducing the amount of sediment that enters the stream in the long term through various types of erosion control. Additionally, gravel augmentation, described in the proposed action will increase the amount of spawning habitat available.

Migratory habitat is essential for juvenile salmonids outmigrating to the ocean as well as adults returning to their natal spawning grounds. Migratory habitat may be affected during the temporary re-routing of the channel during project implementation, however a migratory corridor will be maintained at all times. The proposed action will have long term beneficial effects to migratory habitat. Activities adding complexity to habitat will increase the number of pools, providing resting areas for adults, and the removal of barriers will increase access to habitat.

Misguided restoration efforts often fail to produce the intended benefits and can even result in further habitat degradation. Improperly constructed projects can cause greater adverse effects than the pre-existing condition. The Restoration Manual provides design guidance and construction techniques that facilitate proper design and construction of restoration projects. Properly constructed stream restoration projects will increase available habitat, habitat complexity, stabilize channels and streambanks, increase spawning gravels, decrease sedimentation, and increase shade and cover for salmonids. Since 2004, the percentage of fisheries restoration projects implemented under CDFG's FRGP rated as either good or excellent ranged between 71 to 96 percent, with an average of 87 percent (Collins 2005, CDFG 2006, 2007, 2008, 2009, 2010). NMFS assumes similar success rates will result from the proposed Program due to consistencies in the proposed action. Therefore, most of the proposed restoration actions should continue to be effectively implemented, and thus enhance existing habitat conditions at the project sites.

The sideboards proposed not only limit the duration of effects, also limit the magnitude of the effects. Sediment effects are expected to remain minimal and not accumulate by implementing sideboards that limit the number of, and distance between sediment producing activities.

2. <u>Beneficial Effects to the PCEs</u>

Habitat restoration projects that are funded by the NOAA RC and authorized by the Corps will be designed and implemented consistent with the techniques and minimization measures presented in the Restoration Manual to maximize the benefits of each project while minimizing effects to salmonids. Most restoration projects are for the purpose of restoring degraded salmonid habitat and are intended to improve instream cover, pool habitat, spawning gravels, and flow levels; remove barriers to fish passage; and reduce or eliminate erosion and sedimentation sources. Others prevent fish injury or death, such as screening water diversions. Although some habitat restoration projects may cause small losses to the juvenile life history stage of listed salmonids in the project areas during construction, all of these projects are anticipated to improve salmonid habitat and salmonid survival over the long-term.

a. Instream Habitat Improvements

Instream habitat structures and improvement projects will provide escape from predators and resting cover, increase spawning habitat, improve upstream and downstream migration corridors, improve pool to riffle ratios, and add habitat complexity and diversity. Some structures will be designed to reduce sedimentation, protect unstable banks, stabilize existing slides, provide shade, and create scour pools.

Placement of LWD into streams can result in the creation of pools that influence the distribution and abundance of juvenile salmonids (Spalding et al. 1995, Beechie and Sibley 1997). LWD influences the channel form, retention of organic matter and biological community composition. In small (<10 m bankfull width) and intermediate (10 to 20 m bankfull width) streams, LWD contributes channel stabilization, energy dissipation and sediment storage (Cederholm et al.

1997). Presence and abundance of LWD is correlated with growth, abundance and survival of juvenile salmonids (Fausch and Northcote 1992, Spalding et al. 1995). The size of LWD is important for habitat creation (Fausch and Northcote 1992).

For placement of root wads, digger logs, upsurge weirs, boulder weirs, vortex boulder weirs, boulder clusters, and boulder wing-deflectors (single and opposing), long-term beneficial effects are expected to result from the creation of scour pools that will provide rearing habitat for juvenile coho salmon and steelhead. Improper use of weir and wing-deflector structures can cause accelerated erosion on the opposing bank, however, this can be avoided with proper design and implementation. Proper placement of single and opposing log wing-deflectors and divide logs, will provide long-term beneficial effects from the creation or enhancement of pools for summer rearing habitat and cover for adult salmonids during spawning. Proper placement of digger logs will likely create scour pools that will provide complex rearing habitat, with overhead cover, for juvenile salmonids and low velocity resting areas for migrating adult salmonids. Spawning gravel augmentation will provide long-term beneficial effects by increasing spawning gravel availability while reducing inter-gravel fine sediment concentrations.

Also, for projects where stream bank erosion is a concern, the various weir structures and wing-deflector structures likely to be authorized under the proposed program direct flow away from unstable banks and provide armor (a hard point) to protect the toe of the slope from further erosion. Successfully reducing streambank erosion will offset the increased sediment mobilization into streams from other restoration actions authorized under the proposed program. Boulder faces in the deflector structures have the added benefit of providing invertebrate habitat, and space between boulders provides juvenile salmonid escape cover.

The various weir structures can also be used to replace the need to annually build gravel push up dams. Once these weir structures are installed and working properly, construction equipment entering and modify the channel would no longer be needed prior to the irrigation season. The benefits of reducing or eliminating equipment operation during the early spring reduces the possibility of crushing salmon and steelhead redds and young salmonids.

b. Instream Barrier Modification for Fish Passage Improvement

Instream barrier modification for fish passage improvement projects will improve salmonid fish passage and increase access to suitable salmonid habitat. Long-term beneficial effects are expected to result from these projects by improving passage at sites that are partial barriers, or by providing passage at sites that are total barriers. Both instances will provide better fish passage and will increase access to available habitat.

c. Stream Bank Stabilization

Stream bank stabilization projects will reduce sedimentation from bank erosion, decrease turbidity levels, and improve water quality for salmonids over the long-term. Reducing sediment delivery to the stream environment will improve fish habitat and fish survival by increasing fish embryo and alevin survival in spawning gravels, reducing injury to juvenile salmonids from high concentrations of suspended sediment, and minimizing the loss of quality and quantity of pools from excessive sediment deposition. Successful implementation of stream bank stabilization projects will offset the increased sediment delivery into streams from other restoration actions authorized under the proposed Program. In addition, the various proposed streambank restoration activities are likely to enhance native riparian forests or communities, provide increased cover (large wood, boulders, vegetation, and bank protection structures) and a long-term source of all sizes of instream wood.

d. Fish Passage Improvement at Stream Crossings

Thousands of dilapidated stream crossings exist on roadways throughout the coastal drainages of northern and central California, many preventing listed salmonids from accessing vast expanses of historic spawning and rearing habitat located upstream of the structure. In recent years, much attention has been focused on analyzing fish passage at stream crossings through understanding the relationship between culvert hydraulics and fish behavior (Six Rivers National Forest Watershed Interaction Team 1999).
Reestablishing the linkages between mainstem migratory habitat and headwater spawning/rearing habitat will help to facilitate the recovery of salmonids throughout the action area. Reestablishing passage for listed salmonids into previously unavailable upstream habitat will also likely increase reproductive success and ultimately fish population size in watersheds where the amount of quality freshwater habitat is a limiting factor.

e. Upslope Watershed Restoration

Upslope watershed restoration projects will stabilize potential upslope sediment sources, which will reduce excessive delivery of sediment to anadromous salmonid streams. Some of these projects will reduce the potential for catastrophic erosion and delivery of large amounts of sediment to stream channels. Road improvement projects will reduce sediment delivery to streams in the long-term. Road decommissioning projects should be even more beneficial than road improvement projects in that all or nearly all of the hydrologic and sediment regime effects of the roads would be removed. Long-term beneficial effects resulting from these activities include restored hydrologic function including transport of sediment and LWD, reduced risk of washouts and landslides, and reduced sediment delivery to streams. In the long-term, these projects will tend to rehabilitate substrate habitat by reducing the risk of sediment delivery to streams and restore fish passage by correcting fish barriers caused by roads. Road decommissioning projects will also tend to rehabilitate impaired watershed hydrology by reducing increases in peak flows caused by roads and reducing increases in the drainage network caused by roads.

f. Fish Screens

Water diversions can greatly affect aquatic life when organisms are sucked into intake canals or pipes -- an estimated 10 million juvenile salmonids were lost annually through unscreened diversions in the Sacramento River alone (Upper Sacramento River Fisheries and Riparian Habitat Advisory Council 1989). Once entrained, juvenile fish can be transported to less favorable habitat (*e.g.*, a reservoir, lake or drainage ditch) or killed instantly by turbines. Fish screens are commonly used to prevent entrainment of juvenile fish in water diverted for agriculture, power generation, or domestic use.

Fish screens substantially decrease juvenile fish loss in stream reaches where surface flow is regularly diverted out of channel. Surface diversions vary widely in size and purpose, from small gravity fed diversion canals supplying agricultural water to large hydraulic pumping systems common to municipal water or power production. All screening projects have similar goals, most notably preventing fish entrainment into intake canals and impingement against the mesh screen. To accomplish this, all screening projects covered by this opinion will strictly follow guidelines drafted by CDFG and NMFS, which outline screen design, construction and placement, as well as designing and implementing successful juvenile bypass systems that return screened fish back to the stream channel.

Fish screen projects will reduce the risk for fish being entrained or sucked into irrigation systems. Well-designed fish screens and associated diversions ensure that fish injury or stranding is avoided, and fish are able to migrate through stream systems at the normal time of year.

VII. CUMULATIVE EFFECTS

NMFS must consider both the "effects of the action" and the cumulative effects of other activities in determining whether the action is likely to jeopardize the continued existence of the salmonid ESUs and DPSs considered in this opinion or result in the destruction or adverse modification their designated critical habitat. Under the ESA, cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Listed salmonid species may be affected by numerous future non-federal activities, including timber harvest, road construction, residential development, and agriculture, etc., which are described in the *Environmental Baseline* section.

Non-Federal activities that are reasonably certain to occur within the action area include agricultural practices, water withdrawals/diversions, mining, state or privately sponsored habitat restoration activities on non-Federal lands, road work, timber harvest, and residential growth.

A search of upcoming timber harvest plans on the CalFire website confirms that timber harvesting is expected to continue in the next five years (http://www.fire.ca.gov/ResourceManagement/THPStatusUpload/THPStatusTable.html). NMFS assumes these activities, and similar resultant effects (as described in the *Status of the Species* and *Environmental Baseline* sections), on listed salmonids species will continue through the ten year period of this opinion.

VIII. EFFECTS OF INTERRELATED AND INTERDEPENDENT ACTIONS

No interrelated and interdependent effects are expected to occur as a result of the proposed Program.

IX. INTEGRATION AND SYNTHESIS

SONCC coho salmon populations throughout the action area have shown a dramatic decrease in both numbers and distribution and do not occupy many of the streams where they were found historically. Both the presence-absence and trend data available for SONCC coho salmon suggest that many populations in the larger basins (*e.g.*, Eel and Klamath) continue to decline. The poor condition of their habitat in many areas and the compromised genetic integrity of some stocks pose a serious risk to the survival and recovery of SONCC coho salmon. Based on the above information, recent status reviews have concluded that SONCC coho salmon are "likely to become endangered in the foreseeable future."

Steelhead populations throughout northern California have also shown a decrease in abundance, but are still widely distributed throughout most of the DPS. Although NC steelhead have experienced significant declines in abundance, and long-term population trends suggest a negative growth rate, they have maintained a better distribution overall when compared to the SONCC coho salmon ESU. This suggests that, while there are significant threats to the population, they possess a resilience (based in part, on a more flexible life history) that likely slows their decline. However, the poor condition of their habitat in many areas and the compromised genetic integrity of some stocks pose a risk to the survival and recovery of NC steelhead. Based on the above information, recent status reviews and available information indicate NC steelhead are likely to become endangered in the foreseeable future.

The most recent CC Chinook salmon status review found continued evidence of low population sizes relative to historical abundance. Although mixed abundance trends within some larger watersheds in the north may suggest some populations are persisting, the low abundance, low productivity, and potential extirpations of populations in the southern part of the CC Chinook salmon ESU are of concern. The reduced abundance contributes significantly to long-term risk of extinction, and is likely to contribute to short-term risk of extinction in the foreseeable future. Thus, NMFS concludes the CC Chinook salmon ESU falls far short of historic population numbers and distribution, and is therefore not viable in regards to the population size VSP parameter. The ESU's geographic distribution has been moderately reduced, but especially for southern populations in general, and spring-run Chinook populations in particular. Based on the above information, recent status reviews and available information indicate CC Chinook are likely to become endangered in the foreseeable future.

Currently accessible salmonid habitat throughout the action area has been severely degraded, and the condition of designated critical habitats, specifically their ability to provide for long-term salmonid conservation, has also been degraded from conditions known to support viable salmonid populations. Intensive land and stream manipulation during the past century (*e.g.*, logging, agricultural/livestock development, mining, urbanization, and river dams/diversion) has modified and eliminated much of the historic salmonid habitat in central and northern California. Impacts of concern include alteration of stream bank and channel morphology, alteration of water temperatures, loss of spawning and rearing habitat, fragmentation of habitat, loss of downstream recruitment of spawning gravels and LWD, degradation of water quality, removal of riparian vegetation resulting in increased stream bank erosion, increases in erosion entry to streams from upland areas, loss of shade (higher water temperatures), and loss of nutrient inputs (61 FR 56138).

Although projects authorized under the Program are for the purpose of restoring anadromous salmonid habitat, small amounts of take of listed salmonids will likely result from fish relocation activities and the temporary effects of sediment mobilization, modified hydrology, and other minor effects. NMFS anticipates only small numbers of juvenile salmon and/or steelhead may be adversely affected at each individual restoration project work site. Adverse effects to listed salmonids at these sites are primarily expected to be in the form of short-term behavioral effects with minimal mortality. Salmonids present during project construction may be disturbed, displaced, injured or killed by project activities, and salmonids present in the project work area will be subject to capture, relocation, and related stresses. Most unintentional mortalities of salmon and/or steelhead during fish relocation activities and dewatering will occur exclusively at the juvenile stage. Short-term impacts to salmonid habitat from restoration activities will be minimal and localized at each project site. The duration and magnitude of direct effects to listed salmonids and to designated critical habitat associated with implementation of individual restoration projects will be significantly minimized due to the multiple minimization measures that will be utilized during implementation. NMFS anticipates the effects of individual restoration projects will not reduce the number of returning listed salmonid adults. The temporal and spatial limits (*i.e*., sideboards) included in the proposed action will minimize significant additive effects.

NMFS has determined these effects are not likely to appreciably reduce the numbers, distribution or reproduction of salmon and/or steelhead within each watershed where restoration projects occur. This is based on the Program's numeric limit per year and per watershed, the low percentage of projects that result in direct effects to salmonids and the minor short-term effects resulting from increased turbidity levels. All of the restoration projects are intended to restore degraded salmonid habitat and improve instream cover, pool habitat, and spawning gravel; screen diversions; remove barriers to fish passage; and reduce or eliminate erosion and sedimentation impacts. Although there will be short-term impacts to salmonid habitat associated with a small percentage of projects implemented annually, NMFS anticipates most projects implemented annually will provide long-term improvements to salmonid habitat. NMFS also anticipates that the additive beneficial effects to salmonid habitat over the ten-year period of the proposed action should improve local instream salmonid habitat conditions for multiple life stages of salmonids and should improve survival of local populations of salmonids into the future. Restored habitat resulting from restoration projects should improve adult spawning success, juvenile survival, and smolt outmigration, which will in turn lead to improved abundance, productivity, spatial structure, and diversity within the watershed population. As individual population viability improves, so will the viability of the ESU's and DPS improve as well.

X. CONCLUSION

After reviewing the best available scientific and commercial information; the current status of SONCC coho salmon, CC Chinook salmon, and NC steelhead; the current status and value of their critical habitats; the environmental baseline for the action area; the effects of the proposed restoration projects; and the cumulative effects; it is NMFS's opinion that the proposed Program is not likely to jeopardize the continued existence of SONCC coho salmon, CC Chinook salmon, or NC steelhead, and is not likely to destroy or adversely modify designated critical habitat for the SONCC coho salmon, CC Chinook salmon, or NC steelhead. NMFS also concluded that the project, as proposed, is not likely to adversely affect: (1) southern DPS of Pacific Eulachon, Southern DPS of Green Sturgeon, or Southern Resident Killer Whales; or (2) designated critical habitat for Southern eulachon, or Southern Green Sturgeon.

XI. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without 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 NMFS as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the

ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken by NOAA RC and the Corps so that they become binding conditions of any grant or permit issued for the exemption in section 7(o)(2) to apply. The NOAA RC and Corps have a continuing duty to regulate the activity covered by this incidental take statement. If the NOAA RC or Corps (1) fails to assume and implement the terms and conditions or (2) fails to require an applicant to the Program to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the NOAA RC or the Corps must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

A. Amount or Extent of Take

NMFS expects the proposed project will result in incidental take of listed SONCC coho salmon, CC Chinook salmon, and NC steelhead during the 10-year timeframe. Juvenile coho salmon, steelhead and to a lesser extent stream-type juvenile Chinook salmon will be harmed, injured, or killed from the dewatering and fish relocating activities at the project sites. Specifically, incidental take is expected to be in the form of capture during dewatering and fish relocation activities. NMFS expects no more than 766 juvenile SONCC coho salmon will be annually captured, 0.6 percent of the captured coho salmon will be injured each year, and 0.6 percent of the captured coho salmon will be killed each year. NMFS expects no more than 1502 juvenile NC steelhead will be annually captured, 0.7 percent of the captured steelhead will be injured each year, and 0.6 percent of the captured fish killed each year. NMFS expects no more than 5 juvenile CC Chinook will be captured, and one of those captured Chinook salmon will be injured or killed each year.

B. Effect of the Take

In the accompanying opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to SONCC coho salmon, CC Chinook salmon, or NC steelhead.

C. Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of SONCC coho salmon, CC Chinook salmon, and NC steelhead:

1. Measures shall be taken to minimize the amount or extent of incidental take of listed salmonids resulting from fish relocation, dewatering, or instream construction activities.

2. Measures shall be taken to ensure that individual restoration projects authorized annually through the Program will minimize take of listed salmonids, monitor and report take of listed salmonids, and to obtain specific project information to better assess the effects and benefits of salmonid restoration projects authorized through the Program.

3. Measures shall be taken to handle or dispose of any individual SONCC coho salmon, CC Chinook salmon, or NC steelhead actually taken (mortality).

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the NOAA RC and Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1. The following terms and conditions implement Reasonable and Prudent Measure No. 1, which states that measures shall be taken to minimize the amount or extent of incidental take of listed salmonids resulting from fish relocation, dewatering, or instream construction activities:

    a. Fish relocation data must be provided annually as described in Term and Condition 2b (below). Any injuries or mortality from a fish relocation site that exceeds one percent[7] of a listed species shall be reported to the nearest NMFS office within 48 hours and relocation activities shall cease until a NOAA RC biologist is on site to supervise the remainder of relocation activities.

2. The following terms and conditions implement Reasonable and Prudent Measure 2, which states that measures shall be taken to ensure that individual restoration projects authorized annually through the Program will minimize take of listed salmonids, monitor and report take of listed salmonids, and to obtain specific project information to better account for the effects and benefits of salmonid restoration projects authorized through the Program.

    a. The NOAA RC and/or the Corps shall provide NMFS annual notification of projects that are authorized through the Program. The notification shall be submitted at least 14 days prior to project implementation and must contain specific project information (name of project, type of project, location of project

7 Only when injury or mortality exceeds 5 individuals of the affected species, to minimize the need to report when only a small number of listed species are injured or killed from a small total capture size.

including:, creek, HUC-10 [5th field] watershed, city or town, and county). The annual notification shall be submitted to the Northern California NMFS office:

National Marine Fisheries Service
Northern California Office Supervisor
1655 Heindon Road
Arcata, California 95521

b. In order to monitor the impact to, and to track incidental take of listed salmonids, the NOAA RC and/or the Corps must annually submit to NMFS a report of the previous year's restoration activities. The annual report shall include a summary of the specific type and location of each project, stratified by individual project, 5th field HUC and affected species and ESU/DPS. The report shall include the following project-specific summaries, stratified at the individual project, 5th field HUC and ESU level:

- A summary detailing fish relocation activities, including the number and species of fish relocated and the number and species injured or killed. Any capture, injury, or mortality of adult salmonids or half-pounder steelhead will be noted in the monitoring data and report. Any injuries or mortality from a fish relocation site that exceeds 3 percent of the affected listed species shall have an explanation describing why.

- The number and type of instream structures implemented within the stream channel.

- The length of streambank (feet) stabilized or planted with riparian species.

- The number of culverts replaced or repaired, including the number of miles of restored access to unoccupied salmonid habitat.

- The distance (miles) of road decommissioned.

- The distance (feet) of aquatic habitat disturbed at each project site.

This report shall be submitted annually by March 1 to the Northern California NMFS office:

National Marine Fisheries Service
Northern California Office Supervisor
1655 Heindon Road
Arcata, California 95521

3. The following Term and Condition implements reasonable and prudent measure No. 3, which states that Measures shall be taken to handle or dispose of any individual SONCC coho salmon, CC Chinook salmon, or NC steelhead actually taken (mortality).

    a. All steelhead, Chinook salmon, and coho salmon mortalities must be retained, placed in an appropriately sized whirl-pak or zip-lock bag, labeled with the date and time of collection, fork length, location of capture, and frozen as soon as possible. Frozen samples must be retained until specific instructions are provided by NMFS.

XII. REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the proposed Program to facilitate implementation of fisheries restoration projects in the Northern California region. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal involvement or control over the action has been retained or is authorized by law and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the action that may affect listed species in a manner or to an extent not previously considered in this opinion, (3) the action is subsequently modified in a manner that causes an effect to the listed species is not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

XIII. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS provides the following conservation recommendations:

1. The NOAA RC and/or the Corps should ensure that disturbed and compacted areas will be revegetated with native plant species at the earliest dormant window (late fall through end of winter) following completion of each authorized project. The plant species used

should be specific to the project vicinity or the region of the state where the project is located, and comprise a diverse community structure (plantings should include both woody and herbaceous species). Plant at a minimum ratio of 3 plantings to 1 removed woody plant. Unless otherwise specified, the standard for success is 80 percent survival of plantings or 80 percent ground cover for broadcast planting of seed after a period of 3 years. Revegetation sites will be monitored yearly in spring or fall months for three years following completion of the project. All plants that have died will be replaced during the next planting cycle (generally the fall or early spring) and monitored for a period of three years after planting.

2. The NOAA RC and/or the Corps should incorporate project data into a format compatible with the CDFG/NMFS/Pacific Fisheries Management Council Geographic Information System (GIS) database, ultimately allowing scanned project-specific reports and documents to be linked graphically within the GIS database.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

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Enclosure 2

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT CONSULTATION

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established new requirements for "Essential Fish Habitat" (EFH) descriptions in Federal fishery management plans and required Federal agencies to consult with NOAA's National Marine Fisheries Service (NMFS) on activities that may adversely affect EFH. EFH for Pacific Coast salmon has been described in appendix A, Amendment 14 to the Pacific Coast Salmon Fishery Management Plan. The Corps' administration of the implementation of fisheries restoration activities on private and public lands will affect streams within the regulatory jurisdiction of Corps' San Francisco District in the Mendocino (limited to the Eel River portion of Mendocino County), Humboldt, Del Norte, Siskiyou, and Trinity counties, California, which have been designated EFH for salmon.

Only species managed under a Federal fishery management plan are covered under the MSFCMA. Coho and Chinook salmon are managed under Federal fishery management plans, whereas steelhead are not managed. Therefore, these EFH Conservation Recommendations address only coho and Chinook salmon and do not address steelhead. Pacific groundfish and coastal pelagics will not be affected by the proposed action and are not considered in this consultation.

I. LIFE HISTORY AND HABITAT REQUIREMENTS

Detailed information on the life history and habitat requirements for coho and Chinook salmon is available in the Status of the Species section of the accompanying biological opinion, as well as NMFS status reviews of west coast salmon from Washington, Oregon, and California (Weitkamp *et al*. 1995; Meyers *et al*. 1998; NMFS 2001, 2003; Good *et al*. 2005). In addition, the associated biological opinion for the proposed action summarizes the life history and habitat requirements for coho and Chinook salmon.

II. PROPOSED ACTION

The NOAA RC proposes to fund restoration projects in Humboldt, Del Norte, Trinity, Siskiyou, and a part of Mendocino counties, and the Corps proposes to issue permits under section 10 of the Rivers and Harbors Act of 1899, section 404 of the Federal Water Pollution Control Act, as amended (Clean Water Act (CWA)), or both, from 2012 through 2022. This action will apply to portions of the following counties within coastal counties that are within the regulatory jurisdictional boundaries of the Corps' San Francisco District: Mendocino, Humboldt, Del Norte, Siskiyou, and Trinity. Restoration activities typically occur in watersheds subjected to significant levels of logging, road building, urbanization, mining, grazing, and other activities that have reduced the quality and quantity of instream habitat available for native anadromous salmonids.

Types of authorized projects include: instream habitat improvement, fish passage improvement (including construction of new fish ladders/fishways and maintenance of existing ladders), bank stabilization, riparian restoration, upslope restoration, instream flow augmentation, off channel habitat construction and fish screen installation and maintenance. The majority of the actions considered in this BO follow those described in CDFG's *California Salmonid Stream Habitat Restoration Manual, Third Edition, Volume II* with three new chapters *(Part IX: Fish Passage Evaluation at Stream Crossings, Part X: Upslope Assessment and Restoration Practices, and Part XI: Riparian Habitat Restoration*) added in 2003 and 2004 (Flosi *et al.* 1998), NMFS' *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2000), and NMFS' *Fish Screening Criteria for Anadromous Salmonids* (NMFS 1997).

III. EFFECTS OF THE PROJECT ACTION

EFH will likely be adversely affected by implementation of the Program. As described and analyzed in the accompanying biological opinion, NMFS anticipates some short-term sediment and turbidity will occur up to about 1500 feet downstream of the project locations. Increased turbidity could further degrade already degraded habitat conditions in many of the proposed project locations. Flowing water may be temporarily diverted up to 500 feet around some projects, resulting in short-term loss of habitat space and short-term reductions in macro-invertebrates (food for salmon). Chemical spills from construction equipment may occur, but NMFS believes the chance of spills is low based on the avoidance and minimization measures to be implemented when heavy construction equipment is used.

The duration and magnitude of direct effects to EFH associated with implementation of individual conservation projects will be significantly minimized due to the multiple minimization measures utilized during project implementation. The temporal and spatial scales at which individual restoration project activities are expected to occur in the next ten years of the proposed action will likely preclude significant additive effects. Implementation of the proposed restoration activities is expected to improve the function and value of EFH and short-term adverse effects will be offset by anticipated long-term benefits.

IV. CONCLUSION

After reviewing the effects of the project, NMFS concludes that the project action, as proposed, will adversely affect the EFH of coho or Chinook salmon within streams currently or historically supporting these species in Mendocino, Humboldt, Del Norte, Siskiyou, and Trinity counties.

V. EFH CONSERVATION RECOMMENDATIONS

Section 305(b)(4)(A) of the MSFCMA authorizes NMFS to provide EFH Conservation Recommendations that will minimize adverse effects of an activity on EFH. Although there may be temporary adverse affects associated with the discharge of pollutants being authorized by the Proposed Action, the quality of EFH will be enhanced over the long term and thus NMFS provides no conservation recommendations.

VI. FEDERAL AGENCY STATUTORY REQUIREMENTS

The MSFCMA (Section 305(b)(4)(B)) and Federal regulations (50 CFR Section 600.920(j)) to implement the EFH provisions of the MSFCMA require Federal action agencies to provide a written response to EFH Conservation Recommendations within 30 days of its receipt. A preliminary response is acceptable if final action cannot be completed within 30 days. The final response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. If your response is inconsistent with our EFH Conservation Recommendations, you must provide an explanation for not implementing those recommendations at least 10 days prior to permit issuance.

VIII. LITERATURE CITED

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins. 1998. California Salmonid Stream Habitat Restoration Manual. Third Edition. Inland Fisheries Division. California Department of Fish and Game. Sacramento, California.

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National Marine Fisheries Service. 1997. Fish Screening Criteria for Anadromous Salmonids. NOAA Fisheries Southwest Region, January.

National Marine Fisheries Service. 2000. Final Draft. Guidelines for Salmonids Passage at Stream Crossings. Southwest Region. May 16, 2000.

National Marine Fisheries Service. 2001. Status review update for coho salmon (Oncorhynchus kisutch) from the Central California Coast and the California

Portion of the Southern Oregon/Northern California Coast Evolutionarily Significant Units. Southwest Fisheries Science Center, Santa Cruz Laboratory. April 12. 43 pp.

National Marine Fisheries Service. 2003. Preliminary conclusions regarding the updated status of listed ESUs of West Coast salmon and steelhead. February 2003 Co-manager review draft.

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

Enclosure 3

Number of sediment producing projects authorized in each watershed per year (culvert and dam removals, road decommissioning and upgrades, and off channel habitat enhancements).

HUC 10 Watershed Name	Area (sq. miles)	Sediment Projects	States
Middle Fork Smith River	130.83	4	CA,OR
South Fork Smith River	291.97	6	CA
Smith River-Frontal Pacific Ocean	138.63	4	CA
Point St George-Frontal Pacific Ocean	77.32	3	CA
Redwood Creek	282.38	6	CA
Upper Mad River	120.48	4	CA
Middle Mad River	88.22	3	CA
Lower Mad River	285.62	6	CA
Big Lagoon-Frontal Pacific Ocean	153.42	5	CA
Humboldt Bay-Frontal Pacific Ocean	220.76	5	CA
Rice Fork	96.36	3	CA
Corbin Creek-Eel River	192.45	5	CA
Tomki Creek	64.24	3	CA
Outlet Creek	161.82	5	CA
Bucknell Creek-Eel River	193.65	5	CA
Black Butte River	161.86	5	CA
Upper Middle Fork Eel River	204.93	5	CA
Mill Creek	99.34	3	CA
Elk Creek	115.52	4	CA
Lower Middle Fork Eel River	171.14	5	CA
North Fork Eel River	282.59	6	CA
Woodman Creek-Eel River	166.40	5	CA
Dobbyn Creek	74.88	3	CA
Chamise Creek-Eel River	196.84	5	CA
Basin Creek-Eel River	83.03	3	CA
Larabee Creek	87.92	3	CA
Upper Van Duzen River	85.38	3	CA
Yager Creek	137.02	4	CA
Lower Van Duzen River	205.92	5	CA
Price Creek-Eel River	112.12	4	CA
Salt River-Eel River	96.88	3	CA
Upper South Fork Eel River	203.46	5	CA
East Branch South Fork Eel River	76.09	3	CA
Middle South Fork Eel River	156.86	5	CA
Lower South Fork Eel River	252.32	6	CA
Bear River	82.74	3	CA
Mattole River	296.40	6	CA
Cape Mendicino-Frontal Pacific Ocean	55.93	3	CA
Cooksie Creek-Frontal Pacific Ocean	64.77	3	CA
Cottonwood Creek	99.24	3	CA,OR

Bogus Creek-Klamath River	174.08	5	CA
Humbug Creek-Klamath River	106.29	4	CA
Beaver Creek	108.76	4	CA,OR
Horse Creek-Klamath River	154.08	5	CA
Seiad Creek-Klamath River	127.67	4	CA
Lake Shastina-Shasta River	126.13	4	CA
Willow Creek	87.71	3	CA
Little Shasta River	127.29	4	CA
Parks Creek-Shasta River	328.73	6	CA
Yreka Creek-Shasta River	123.57	4	CA
East Fork Scott River	115.43	4	CA
French Creek-Scott River	180.03	5	CA
Moffett Creek	123.22	4	CA
Kidder Creek-Scott River	122.99	4	CA
Indian Creek-Scott River	119.34	4	CA
Lower Scott River	152.50	5	CA
Indian Creek	134.69	4	CA
Thompson Creek-Klamath River	105.04	4	CA
Elk Creek	95.05	3	CA
Clear Creek	111.40	4	CA
Dillon Creek	73.11	3	CA
Ukonom Creek-Klamath River	137.32	4	CA
Rock Creek-Klamath River	108.61	4	CA
Bluff Creek-Klamath River	273.10	6	CA
Blue Creek	125.43	4	CA
Tectah Creek-Klamath River	260.31	6	CA
Turwar Creek-Klamath River	106.28	4	CA
South Fork Salmon River	289.98	6	CA
North Fork Salmon River	203.74	5	CA
Wooley Creek	148.62	4	CA
Salmon River	108.36	4	CA
Browns Creek	73.55	3	CA
Weaver Creek-Trinity River	221.75	5	CA
Canyon Creek	64.06	3	CA
North Fork Trinity River	152.20	5	CA
New River	233.56	5	CA
Big French Creek-Trinity River	270.03	6	CA
Horse Linto Creek-Trinity River	302.96	6	CA
Upper South Fork Trinity River	115.03	4	CA
Upper Hayfork Creek	165.04	5	CA
Lower Hayfork Creek	221.95	5	CA
Middle South Fork Trinity River	227.64	5	CA
Lower South Fork Trinity River	201.73	5	CA
North Fork Smith River	157.97	5	CA,OR

Cape Ferrelo Frontal	61.54	3	CA,OR
Winchuck River	71.25	3	CA,OR

Enclosure 4

Sample Application and Monitoring Checklists

Application Date:

Expected Project Start Date:

Expected Project End Date:

Project Name:

Project Location:

Applicant Name:

Landowner Name:

Stream:

Watershed (per Calwater 2.2.1):

GPS Location (indicate latitude longitude decimal degrees):

Describe current problem, solution and proposed benefits of your project.				
Describe methods of implementation (*i.e.*, hand crews, heavy equipment, chain saws).				
What minimization and avoidance measures will be implemented for this project.				
	Yes	**No**	**N/A**	**Notes**
Salmonid Species Present:				
1. Steelhead				
1.a. Northern California (NC) steelhead				
2.a. Central California Coast (CCC) steelhead				
3.a. South-Central California Coast (SCCC) steelhead				
2. Coho				
1.a. Southern Oregon / Northern California Coast (SONCC) coho				
2.a. Central California Coast (CCC) coho				
3. Chinook				
1.a. California Coastal (CC) chinook				
Project Types Requiring Additional Oversight:				

1. Please indicate if the project includes any of the following:				
1.a. Culvert retrofit and installation				
	Yes	**No**	**N/A**	**Notes**
1.b. Construction of new fish ladders				
1.c. Retrofitting of older fish ladders				
1.d. Removal of flashboard dams				
2. For stream crossing projects, does the proposed project pass all life stages of covered salmonid species that historically passed there? (Section II.A.4)				
2.a. Supporting documentation provided				
3. Proposed retrofit culverts meet the fish passage criteria for the passage needs of the listed species and life stages historically passing through the site prior to the existence of the road crossing (Section II.A.4)				
3.a. Supporting documentation provided				
4. Designs for fish ladders and culvert replacement or modifications are designed and stamped by a registered engineer. (Section II.A.4)				
4.a. Supporting documentation provided				
5. For fish ladder projects verify the following: (Section II.A.4 & Appendix 1.J)				
5.a. Fish ladder is less than 30 feet in height. (Section II.A.4)				
5.b. New ladder is designed to provide passage conditions suitable for year round bidirectional juvenile salmonid movement (Section II.A.4)				
5.c. New ladders have a maximum jump of six inches (Section II.A.4)				
5.d. Documentation of NMFS/CDFG written sign-off				
General Protection Measures:				
6. For fish screen installation, verify the following:				
6.a. Fish screen complies with NMFS/CDFG fish screen criteria				
6.b. Documentation of written sign off				
7. For placement of weirs and concrete lined channels				
7.a. Documentation of NMFS/CDFG written engineering sign off				
8. Verify that construction activities will occur between June 15 to October 15 (Appendix 1.A.5)				
9. Will construction occur within 200 feet of established				

riparian vegetation or other bird nesting habitats? (Appendix 1.A.5)				
9.a. If yes, verify that construction will start after August 1				
10. If poured concrete is used it shall be excluded from the wetted channel for a period of 30 days after it is poured or will be coated with appropriate sealant (Appendix 1.A.6)				
11. Rock used for bank stabilization or to anchor LWD structures, will be large and heavy enough to remain stationary under the 100 year median February flow event (Appendix 1.A.8)				
12. Verify that disturbance footprint of the projects staging areas will not exceed 0.25 acres (Section II.C.1.b)				
13. Will the project require dewatering of the work site?				
13.a. If yes, has (or will) the project proponent coordinated the project site dewatering with a qualified biologist to perform fish and amphibian relocation activities? The qualified biologist(s) must possess a valid State of California Scientific Collection Permit as issued by the CDFG and will be familiar with the life history and identification of listed salmonids and listed herptiles within the action area (Appendix 1.B.1.d)				
13.b. The length of stream dewatered does not exceed 300 feet (Section II.C.1.a)				
	Yes	**No**	**N/A**	**Notes**
14. The requirements outlined in the Program Description section entitled, *"General Conditions for all Fish Capture and Relocation Activities"* have been reviewed and applicable measures will be adhered to during implementation of the project (Appendix 1.B)				
14.a. Supporting documentation provided				
Measures to Minimize Disturbance from Instream Construction:				
15. The requirements outlined in the Program Description section				

entitled *"Measures to Minimize Disturbance from Instream Construction"* have been reviewed and applicable measures will be adhered to during implementation of the project (Appendix 1.D)				
15.a. Supporting documentation required				
Measures to Minimize Degradation of Water Quality:				
16. The requirements outlined in the Program Description section entitled *"Measures to Minimize Degradation of Water Quality"* have been reviewed and applicable measures will be adhered to during implementation of the project (Appendix 1.E.)				
16.a. Supporting documentation provided				
Measures to Minimize Loss or Disturbance of Riparian Vegetation:				
17. Native trees with defects, large snags > 16 inches (in) diameter breast height (dbh) and 20 ft high, cavities, leaning toward the stream channel, with active bird nests, late seral characteristics, or > 36 in dbh will be retained (Section II.C.1.b)				
17.a. All other applicable requirements outlined in *"Measures to Minimize Loss or Disturbance of Riparian Vegetation"* have been reviewed and applicable measures will be adhered to during project implementation (Appendix 1.H.)				
17.b. Supporting documentation provided				
18. Downed trees (logs) > 24 in dbh and 10 ft long will also be retained on upslope sites (Section II.C.1.b)				
Measures to Minimize Impacts to Non-Surfaced Roads in Project Area:				
19. The requirements outlined in the Program Description section entitled *"Measures to Minimize Impacts to Non-Surfaced Roads in Project Area"* have been reviewed and applicable measures will be adhered to during implementation of the project (Appendix 1.I)				
19.a. Supporting documentation provided				
Additional Project Information:				
20. Does the project propose the use of gabion baskets?				
21. Does the project propose use of cylindrical riprap				

(aqualogs)?				
22. Does the project propose use of chemically-treated timbers for grade or channel stabilization structures, bulkheads or other instream structures?				
23. Will the completed project substantially disrupt the movement of aquatic species indigenous to the waterbody, including those species that normally migrate through the action area?				
24. Will the project completely eliminate a riffle/pool complex?				
25. Does the project proponent propose to dewater more than 300 ft of stream?				
26. Does the project propose use of undersized rock within ordinary high water (rock incapable of withstanding a 100 year flow event)?				
Monitoring (Appendix 2.A):				
27. Pre-project photos attached (from minimum of four cardinal directions)				
28. The project applicant has reviewed all monitoring requirements necessary for coverage under this biological opinion and will submit reports as required	**Initials:**			

Please provide an explanation of any proposed deviations from the Program requirements as an attachment.

Signature:
By signing below, I certify all of the information indicated above is accurate. I have also reviewed the project description and terms and conditions of the biological opinion, and agree to comply:

== ===============
Applicant Date

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

JUN 14 2016

Refer to NMFS No: WCR-2015-3755

Patrick Rutten
NOAA Restoration Center Supervisor
National Marine Fisheries Service
777 Sonoma Avenue, Room 219A
Santa Rosa, California 95404

Aaron O. Allen, Ph.D.
Acting Regulatory Branch Chief
U.S. Department of the Army
San Francisco District, Corps of Engineers
1455 Market Street
San Francisco, California 94103-1398

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Program for restoration projects within the NOAA Restoration Center's Central Coastal California Office jurisdictional area in California

Dear Mr. Rutten and Dr. Allen:

Thank you for your letter of November 3, 2015, 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 NOAA Restoration Center and the U.S. Army Corps of Engineers (Corps) review and permit restoration projects (Program) within NMFS' Santa Rosa Office jurisdictional area in California.

This document transmits NMFS biological opinion (BO) and Essential Fish Habitat (EFH) consultation, based on our review of the NOAA Restoration Center (RC) proposal to review fisheries restoration projects and the Corps' proposal to permit these projects pursuant to section 404 of the Clean Water Act (33 U.S.C. 1344) and section 10 (§10) of the Rivers and Harbors Act of 1899. The biological opinion analyzes the effects of the proposed action on endangered Central California Coast (CCC) coho salmon (*Oncorhynchus kisutch*), and threatened Northern California (NC) steelhead (*O. mykiss*), threatened CCC steelhead, threatened South-Central California Coast (S-CCC) steelhead, California Coastal (CC) Chinook (*O. tshawytscha*), and their designated critical habitats in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

NMFS concludes the RC and Corps' proposed action is not likely to jeopardize the continued existence of threatened CCC steelhead, S-CCC steelhead, NC steelhead, CC Chinook and endangered CCC coho salmon, or adversely modify or destroy designated critical habitats for listed salmonids and, therefore, an incidental take statement is included with this BO. The incidental take statement includes reasonable and prudent measures necessary and appropriate to minimize incidental take of these species. In addition, this letter transmits our concurrence that the proposed action is not likely to adversely affect certain ESA listed species.

NMFS also concludes the proposed actions will have minimal adverse effects to Chinook salmon and coho salmon, Pacific groundfish, and Coastal pelagic EFH. Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), authorizes NMFS to provide EFH Conservation Recommendations to minimize adverse effects of an activity to EFH. Because adverse effects to EFH will be minimal and multiple habitat conservation measures are included in the project description and appendices, EFH Conservation Recommendations are not necessary. However, if the proposed action is modified in a manner that may adversely affect EFH, the RC and Corps will need to reinitiate EFH consultation with NMFS.

Please contact Tom Daugherty at (707) 469-4057, Tom.Daugherty@noaa.gov if you have any questions concerning this section 7 consultation, or if you require additional information.

Sincerely,

for

William W. Stelle, Jr.
Regional Administrator

Enclosure

cc: Joe Pecharich, NOAA Restoration Center
Holly Costa, Army Corps of Engineers
Katerina Galacatos, Army Corps of Engineers
NMFS File No: 151422WCR2016SR00226
Copy to Chron File

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

Program to fund, and/or permit restoration projects within the NOAA Restoration Center's Central Coastal California Office jurisdictional area in California

NMFS Consultation Number: WCR-2015-3755
Action Agencies: National Oceanic and Atmospheric Administration's Restoration Center (RC) and United States Army Corps of Engineers, San Francisco District

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species or Critical Habitat?*	Is Action Likely To Jeopardize the Species?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
CCC coho salmon (*Oncorhynchus kisutch)*	Endangered	Yes	No	No
California coastal Chinook (*O. tshawytscha*)	Threatened	Yes	No	No
NC steelhead (*O. mykiss*)	Threatened	Yes	No	No
CCC steelhead (*O. mykiss*)	Threatened	Yes	No	No
S-CCC steelhead (*O. mykiss*)	Threatened	Yes	No	No
Green Sturgeon (*Acipenser medirostris*)	Threatened	*No		

*Please refer to section 2.11 for the analysis of species or critical habitat that are not likely to be adversely affected.

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	No
Pacific Coastal Groundfish	Yes	No
Coastal Pelagic	Yes	No

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

Issued By: for

William W. Stelle, Jr.
Regional Administrator

Date: JUN 14 2016

Table of Contents

1. INTRODUCTION

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

1.1 Background

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

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

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available through NMFS' Public Consultation Tracking System [https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts]. A complete record of this consultation is on file at NMFS office in Santa Rosa, California.

1.2 Consultation History

On November 3, 2015, NOAA's National Marine Fisheries Service (NMFS) received a letter from the NOAA Restoration Center (RC) requesting formal consultation pursuant to section 7(a)(2) of the Endangered Species Act (ESA), as amended (16 U.S.C. § 1531 *et seq*.), and its implementing regulations (50 CFR § 402). The request for consultation was in regards to NOAA Restoration Center's Central Coastal California Office Restoration Program (Program) implemented by the NOAA Restoration Center (RC) and the Army Corps of Engineers (Corps) that will fund and permit restoration actions within the NOAA Restoration Center's Santa Rosa Office jurisdictional area. Included in the consultation package was a Biological Assessment (BA) for the proposed action titled "*Biological Assessment for Fisheries Habitat Restoration Projects in the Jurisdiction of the NMFS Santa Rosa Office*", dated November 2, 2015. This consultation also included one meeting NMFS and the RC staff on December 11, 2016, when the package was deemed complete. This consultation meeting resulted in some changes to the original proposed action analyzed in the BA, including the increase in project size for dewatering projects.

The consultation concerns the effects of the proposed program and associated restoration activities on endangered Central California Coast (CCC) coho salmon (*Oncorhynchus kisutch*), threatened Northern California (NC), CCC, and South-Central California Coast (S-CCC) steelhead (*Oncorhynchus mykiss*), and threatened California Coastal (CC) Chinook salmon (*Oncorhynchus tshawytscha*). Designated critical habitat for CCC coho salmon, CCC and S-CCC steelhead, NC steelhead, and CC Chinook may be affected by the proposed projects included in the Program.

1.3 Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02).

The RC proposes to fund restoration projects in Humboldt (CCC Coho ESU only), Mendocino (excluding the Eel and Mattole River watersheds), Sonoma, Marin, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Francisco, San Mateo, Santa Cruz, San Benito, Monterey and San Luis Obispo counties (Figure 1). The Corps proposes to issue permits for the proposed projects under section 10 of the Rivers and Harbors Act of 1899, and section 404 of the Federal Water Pollution Control Act, as amended (Clean Water Act (CWA)), as necessary. The restoration projects will be within the NMFS's Santa Rosa Office jurisdictional area (Figure 1) and include projects permitted from 2016 forward into the future. Proposed restoration projects are categorized as follows: instream habitat improvements, instream barrier modification for fish passage improvement, streambank and riparian habitat restoration, upslope watershed restoration, removal of small dams (permanent, flashboard and other seasonal), creation of off-channel/side-channel habitat features and water conservation projects (developing alternative off-stream water supply, water storage tanks, , and water measuring devices). Projects that will not be authorized under this program include water diversion or required bypass flow requirements, flow operations from dams, large construction projects, or other projects requiring take authorization that are not specific to RC restoration proposed actions described below.

RC staff in Santa Rosa, California will administer and oversee the program to facilitate implementation of the restoration projects occurring in the jurisdiction of the Santa Rosa Office of NOAA's National Marine Fisheries Service (Program). This biological opinion analyzes projects that meet the restoration project requirements set forth by the RC, and require a Corps permit. All restoration projects included in the Program and analyzed by this biological opinion will be subject to the administration process described in Section 1.5, *Oversight and Administration*. Restoration projects may be submitted to the Program by either the Corps or the RC. The RC will take the lead for the Program and participate in the screening of individual projects under consideration for inclusion in the Program, and will track implementation of individual projects. Such tracking will include documentation and reporting to the NMFS Santa Rosa Office of the number, type and location of projects and any incidental take that result from individual projects under this Program.

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

Habitat restoration projects authorized by the Program will be designed and implemented following the techniques and minimization measures presented in CDFW's *California Salmonid Stream Habitat Restoration Manual, Fourth Edition, Volume II, Part IX: Fish Passage Evaluation at Stream Crossings; Part X: Upslope Assessment and Restoration Practices; Part XI: Riparian Habitat Restoration; and Part XII: Fish Passage Design and*

Implementation (Flosi *et al.* 2010, hereafter referred to as "CDFW Manual") in order to maximize the benefits of each project while minimizing potential short-term, adverse impacts to salmonids, other aquatic and terrestrial species, and stream and riparian habitat. Additionally, Program restoration project activities that are not described in the current CDFW Manual will also be part of the proposed Program and are listed below starting at 1.3.5.

Additional avoidance and minimization measures will be necessary for all projects in order to reduce the potential for ancillary impacts to both salmonids and other riparian and aquatic species and their habitats. These measures are described under "*Section 1.3.7 Protection Measures.*"

1.3.1 Program Activities Described in the CDFW Manual

1.3.1.1 Instream Habitat Improvements

Instream habitat structures and improvements are intended to provide predator escape and resting cover, increase spawning habitat, improve upstream and downstream migration corridors, improve pool to riffle ratios, and add habitat complexity and diversity. Specific techniques for instream habitat improvements may include: placement of cover structures (divide logs; engineered logjams; complex wood jams; digger logs; spider logs; and log, root wad, and boulder combinations, *etc.*), boulder structures (boulder weirs, vortex boulder weirs, boulder clusters, and single and opposing log wing-deflectors, *etc.*), log structures (log weirs, upsurge weirs, single and opposing log wing-deflectors, engineered log jams, and Hewitt ramps, *etc.*), and placement of imported spawning gravel. Implementation of these types of projects may require the use of heavy equipment (*i.e.*, self-propelled logging yarders, mechanical excavators, backhoes, helicopters, *etc.*), however, hand labor will be used when possible. Large woody debris (LWD) may also be used to enhance pool formation and improve stream reaches. Projects may include both anchored and unanchored logs, depending on site conditions and wood availability. Depending upon complexity of the project after it is reviewed by an RC technical monitor, a NMFS or CDFW engineer will be given the chance to review and comment on select projects' designs if needed and decide the level of review required.

1.3.1.2 Instream Barrier Modification for Fish Passage Improvement

Instream barrier modification projects are intended to improve anadromous salmonid passage and increase access to currently inaccessible or difficult-to-access salmonid habitat. Projects may include those designed to improve fish passage at existing culverts, bridges, small dams, flood control structures, and paved and unpaved fords, or Arizona crossings, through replacement, removal, or retrofitting of these existing structures. These projects may include the use of gradient control weirs upstream or downstream of the barriers to control water velocity, water surface elevation, and/or provide sufficient pool habitat to facilitate jumps. Also, interior baffles or weirs may be used to mediate velocity and the effects of shallow sheet flow, or roughened ramps to provide stability and make up grade around other in-stream structures. Weirs and baffles may also be used to improve passage in flood control channels (particularly concrete-lined channels). Implementing these types of projects may require the use of heavy equipment (*i.e.* mechanical excavators, backhoes, cranes, *etc.*).

Part IX of the CDFW Manual, *Fish Passage Evaluation at Stream Crossings*, provides consistent methods for evaluating fish passage through culverts at stream crossings, and will aid in assessing fish passage through other types of stream crossings, such as bridges and paved or hardened fords. The objectives of Part IX are to provide the user with: consistent methods for evaluating salmonid passage though stream crossings; ranking criteria for prioritizing stream crossing sites for treatment; treatment options to provide unimpeded fish passage; a stream crossing remediation project checklist; guidance measures to minimize impacts during stream crossing remediation construction; and methods for monitoring the effectiveness of corrective treatments.

The most recent chapter in the CDFW Manual (Part XII), *Fish Passage Design and Implementation,* provides technical guidance for the design of fish passage projects at stream crossings, small dams and water diversion structures. The objectives of CDFW Part XII are to "guide designers through the general process of selecting a design approach for passage improvement." It provides "concepts, a design framework, and procedures to design stream crossings and fishways that satisfy ecological objectives, including: efficient and safe passage of all aquatic organisms and life stages, continuity of geomorphic processes such as the movement of debris and sediment, accommodation of behavior and swimming ability of organisms to be passed, diversity of physical and hydraulic conditions leading to high diversity of passage opportunities, projects that are self-sustaining and durable, and passage of terrestrial organisms that move within the riparian corridor (Flosi *et al.* 2010)."

Projects that are authorized under the Program must be designed and implemented consistent with CDFW's *Culvert Criteria for Fish Passage* (Appendix IX-A, CDFW Manual, Flosi *et al.* 2010). A NMFS or CDFW engineer will be given the chance to review and comment and make recommendations on all fish passage improvement project designs.

1.3.1.3 Stream Bank and Riparian Habitat Restoration

The proposed activities will seek to reduce excess fine sediment from bank erosion by restoring incised or failing stream banks with appropriate site-specific techniques including: laying back stream banks, creating inset floodplains, and installing tree and native plant material revetments, willow wall and rootwad revetments, bank laybacks, brush mattresses, natural fiber rolls, and exclusionary fencing. These projects must improve salmonid habitat through increased stream shading that will lower stream temperatures, increased future LWD recruitment and invertebrate production, and increased instream habitat complexity. Riparian habitat restoration projects will aid in the restoration of riparian habitat by increasing the number of plants and plant groupings, and could include the following types of projects: natural native plant regeneration, bank laybacks, inset floodplains, livestock exclusionary fencing, bioengineering, removal of non-native trees (*e.g.*, eucalyptus trees) and revegetation projects. Reducing excessive fine instream sediment will improve fish habitat and fish survival by increasing fish embryo and alevin survival in spawning gravels, reducing injury to juvenile steelhead from high concentrations of suspended sediment, and minimizing the loss, or reduction in size, of pools from excess sediment deposition. Improved instream habitat complexity will help to ensure that failing stream banks do not result in continued loss of the in-channel habitat complexity needed by salmonids.

Part XI of the CDFW Manual, *Riparian Habitat Restoration,* contains some examples of these techniques. Some guidelines for stream bank restoration techniques are described in Part VII of the CDFW Manual, *Project Implementation*. Implementing these project types may require the use of heavy equipment. Depending upon complexity of the project after it is reviewed by RC technical monitor, a NMFS or CDFW engineer may be given the chance to review and comment on all project designs and decide level of review.

Proposed use of boulders must be limited in scope and quantity to the minimum necessary to stabilize the slope and protect it from expected stream flows during storm events. Boulder structures must be part of a larger restoration design with the primary purpose of providing habitat improvements, and must include a riparian revegetation plan. Bridge abutments and other structural improvements installed in the restoration design of fish passage projects may require additional boulder and rock bank stabilization. This Program is not meant to cover projects that are merely protecting private property bank erosion issues.

1.3.1.4 Upslope Watershed Restoration

Upslope watershed restoration projects will reduce excessive delivery of sediment to salmonid streams. Part X of the CDFW Manual, *Upslope Assessment and Restoration Practices*, describes methods for identifying and assessing erosion problems, evaluating appropriate treatments, and implementing erosion control treatments in salmonid watersheds. Road-related upslope watershed restoration projects will include: road decommissioning, road upgrading, and storm proofing roads. Implementation of these types of projects may require the use of heavy equipment.

1.3.2 Program Activities Not Described in the CDFW Manual

1.3.2.1 Removal of Small Dams (permanent, flashboard and other seasonal-type)

Dam removal is conducted to restore fisheries access to historic habitat for spawning and rearing and to improve long-term habitat quality and proper stream geomorphology. Types of eligible small dams include permanent, flashboard types, earthen and seasonal dams with the characteristics listed below.

Definition of a small dam is defined by the California Division of Dam Safety as any artificial barrier that is either: a) less than 25 feet in height from the natural bed of the stream or watercourse at the downstream toe of the barrier, or from the lowest elevation of the outside limit of the barrier to the maximum possible water storage elevation, or b) designed to have an impounding capacity of less than 50 acre-feet. This Program activity only includes small dam (as defined above) removal projects that will form a channel at natural grade and shape upstream of the dam, either naturally or through excavation, in order to minimize negative effects on downstream habitat. Dam removal projects will: 1) have a small volume of sediment available for release (relevant to the size of the stream channel, that when released by storm flows, will have minimal effects on downstream habitat (verified by qualified engineer and reviewed by either CDFW or NMFS engineers), or 2) be designed to remove sediment trapped by the dam down to the elevation of the target thalweg, including design channel and floodplain dimensions. This can be accomplished by estimating the natural thalweg using an adequate longitudinal profile (see CDFW Manual Part XII Fish Passage

Design and Implementation) and designing a new channel that provides the same hydraulic conditions and habitat for listed fish as the historical, pre-dam channel.

Methods of restoring the channel: Implementing small dam removal projects may require the use of heavy equipment (*e.g.*, self-propelled logging yarders, mechanical excavators, backhoes, *etc.*). Some small dam removals can be accomplished with hand tools, such as jackhammers. One of two methods will be used to restore the channel in a small dam removal project: Natural channel evolution or "stream simulation" design. The conditions under which each of these methods may be used are as follows:

Natural channel evolution: The natural channel evolution approach to restoring a channel bed consists of removing all hardened portions (by hand efforts or heavy equipment) of a dam and allowing the stream's natural flows to naturally shape the channel through the project reach over time. This method shall only be used in the following situations: 1) risks are minimal to any of the downstream habitats and the aquatic organisms inhabiting them (based upon the amount and size gradation of the material being stored above the dam) if all of the sediment upstream of the dam is released during a single storm event; 2) the project reach has sufficient space and can be allowed to naturally adjust based upon any land constraints with minimal risk to riparian habit; 3) project implementation should follow procedures that have been documented as having been successfully performed elsewhere under similar circumstances; and 4) notching the dam in increments after periodic storm events in order to reduce the amount of sediment being released during any individual storm event shall not be permitted unless project funding is sufficient to allow the dam to be completely removed within the proposed project timeframe.

Stream simulation: Stream simulation design relies upon trying to duplicate the morphological conditions observed within a natural reference reach throughout the project reach. Stream simulation designs should be used in situations where excessive sediment releases pose a threat to downstream habitat and organisms. Specifically, the sediment upstream of the dam will be physically removed and the channel through the excavated reach will be designed using stream simulation. Stream simulation designs shall be conducted in accordance with known stream restoration and fish passage guidance documents. This specifically includes: 1) the identification of a suitable reference reach; 2) quantification of the average cross-sectional shape, bank full width, bed and bank sediment grain size distributions, and the geomorphic features of the channel (*e.g.,* pool-riffle sequences, meander lengths, step pools, *etc.*); and 3) reproducing the geomorphic features found within the reference reach in the project reach.

1.3.2.2 Creation of Off-channel/Side-channel Habitat Features

Floodplain habitats such as wetlands, sloughs, and off-channel features are important habitat areas for salmonids, particularly during winter months, providing velocity refugia during high winter flow events and improving growth and survival of rearing juveniles (Tschaplinski 1988, Aitkin 1998, Martens and Connolly 2014). Although projects to increase off-channel and side-channel habitats are relatively new to California, many such projects have been built in western Washington and Canada. Estuarine restoration projects may include off-channel and side-channel habitat components that can provide rearing habitat for salmonids.

Historically, off-channel habitats were much more prevalent in the estuaries and lower reaches of California streams. Much of this off-channel habitat has been lost due to development such as road construction, urbanization, agriculture and associated fill (especially for Highways 1 and 101), rail line construction and associated fill, and other anthropogenic activities. Habitat complexity and ecological function have either been degraded or lost.

The type of side-channel or off-channel features proposed for inclusion under the proposed approach:

- Reconnection of abandoned side-channel or pond habitats to restore fish access.
- Connection of adjacent ponds, remnants from aggregate excavation.
- Reconnection of oxbow lakes on floodplains that have been isolated from the meandering channel by river management actions, or channel incision.
- New side-channel or off-channel habitat features that create self-sustaining channels that will be maintained through natural processes.
- Increasing the hydrologic connection between floodplains and or wetlands to main channels.

Projects that require the installation of a flashboard dam, head gate or other mechanical structure will not be considered. Off-channel ponds constructed under this programmatic consultation will not be used as a point of water diversion. Use of logs or boulders as stationary water level control structures will be allowed.

Projects that enhance or create off-channel/side-channel areas will provide important rearing areas and velocity refugia for salmonids. These restoration projects may include: removal or breaching of levees and dikes, channel and pond excavation, constructing wood or rock tailwater control structures, beaver dam analogues and construction of large woody material and rock boulder habitat features. Implementation of these types of projects may require the use of heavy equipment and construction of temporary access roads.

Information regarding consideration of water supply (channel flow/overland flow/ groundwater), water quality, and water source reliability; risk of channel change; as well as channel and hydraulic grade must be provided by project proponent for a possible NMFS or CDFW engineer to review. Project design and data must include characterizations such as those listed in Section 5.1.2, Side-Channel/Off-Channel Habitat Restoration, in the Washington Department of Fish and Wildlife's 2004 Stream Habitat Restoration Guidelines (Saldi-Caromile *et al.* 2004) and Chapter 6: Beaver Dam Analogues from the US Fish and Wildlife Service, National Oceanic and Atmospheric Administration, Portland State University, US Forest Service 2015 Beaver Restoration Guidebook, (Castro *et al.* 2015).

1.3.2.3 Water Conservation Projects

Water conservation projects are intended to increase local stream flow, and thus available stream rearing habitat. In addition, increased stream flow may increase spawning and rearing habitat, improve or reconnect upstream and downstream migration corridors, improve access to habitat, decrease water temperatures and increase dissolved oxygen and nutrient transport. Specific techniques for water conservation projects may include: developing an alternative off-stream water supply (installation/modification of wells and ponds); creating tail water collection ponds; improving infrastructure; installing water storage tanks; installing infiltration galleries, piping ditches and/or re-profiling ditches; and installing head gates and water measuring devices. Implementation of these types of projects may require the placement of infrastructure (head gates, pumps and piping) in or adjacent to the stream to provide alternative water intake facilities. Water conservation projects proposed under the Program will not create fish passage barriers. Mechanized equipment may be used to install the water conservation infrastructure, but hand labor will be utilized when possible. Pumping activities will not take more than 10% of the wetted channel at a time and will not strand salmonids. All instream pumps associated with tank projects will be screened in accordance with CDFW/NMFS screening criteria. All water conservation projects will require diverters to verify compliance with California state water rights.

a. Developing Alternative Off-stream Water Supply

Many landowners use off-stream reservoirs or ponds for agricultural uses to store water used for animals (*e.g.* dairies or pastures for grazing), vineyards or farms. These are often reservoirs that are filled either by wells or by pumping groundwater. The proposed Program will cover ponds and also cover water lines, watering troughs, and other physical components used to provide groundwater to livestock, vineyards, farms and other uses.

b. Water Storage Tanks

Creating off-channel water storage infrastructure will reduce the need for diversions during the low-flow season (late spring, summer and fall). These tanks could either be filled through rainwater catchment or by pumping surface or groundwater flow. Under this programmatic consultation, all water storage tank projects will be required to have a forbearance agreement for at least 15 years, which will provide temporal and quantitative assurances for pumping activities. The exact low-flow threshold for this programmatic consultation will be determined in collaboration with RC and NMFS hydrologists on a site-by-site basis.

c. Installation of water measuring devices

Water measuring devices include stream gauges and staff plates. While installation of stream gauges and staff plates typically only requires hand tools (*e.g.*, shovels to bury inlet pipes, *etc.*), installation or replacement can require minor site excavation. Heavy equipment from the top-of-bank is typically used for excavation of the site. Any work areas will be hydrologically isolated from fish bearing streams. If the gauge is located within or near flood-prone areas, typically rock or other “armoring” is installed to protect the gauge from scour and debris damage.

1.3.3 Number and Location of Anticipated Projects

The number of restoration projects implemented on a yearly basis will be influenced by the available funding, interest from and capacity of, restoration proponents to submit qualified project applications, project permitting and construction scheduling, and other factors. Potential sources of funding for stream restoration projects in this region that would be included in the Program are numerous across various agencies.

Approximately 35-40 projects are expected to be authorized each year under this programmatic approach (Program). It is possible that once this Program is in place, there will be increased interest among the restoration community to participate in this Program. Therefore, the Corps and RC propose a maximum of 40 projects per year to be authorized under the Program to provide for increased project activity as a result of this effort. There will also be an annual per-watershed limitation of three projects occurring in any one HUC 12 (10 to 40k acres) watershed per year to avoid numerous sediment-producing restoration projects within the same watershed. For projects such as dam removal and road decommissioning or upgrading which can cause more disturbance and sediment delivery, the Program will limit these to one dam removal and one road project per HUC 12 watershed.

1.3.4 Limitations on Size and Footprint of Projects

Adverse impacts that may result from construction activities authorized under this programmatic consultation would occur on a localized scale. In order to further minimize the potential for short-term adverse impacts, the following limitations apply to individual projects and to the total number of projects that can be authorized under the proposed programmatic consultation each year:

a. Limits on Area of Disturbance and Construction Timing for Individual Projects:

Limits on stream crossing projects:

1. Any stream crossing removals in a salmonid bearing stream must be 1500 meters apart.

2. Crossings in a non-fish bearing stream must be 100 feet apart.

Maximum length of stream dewatered per project: 1,000 linear feet

Maximum upslope disturbance (raw dirt, tree removal, canopy cover reduction):

1. The disturbance footprint for a project's staging areas may not exceed a total of 1 acre.

2. Native trees with defects, large snags > 16 in. diameter at breast height (dbh) and 20 ft. high, cavities, leaning toward the stream channel, nests, late seral characteristics, or > 48 in. dbh will be retained. In limited cases removal will be permitted if trees/snags occur in the way of providing fish passage. No removal will occur without a site visit and written approval from the RC.

3. Downed trees (logs) > 24 in. dbh and 10 ft. long will be retained on upslope sites or used for instream habitat improvement projects.

1.3.5 Oversight and Administration

The following section outlines the proposed process for administration of projects under the proposed Program. Corps and RC staff will communicate directly with staff from NMFS to ensure efficient and productive use of the Program. RC staff will provide for the tracking and oversight of all projects that are implemented under Program. In addition, an informal team comprised of staff from the RC and the Corps-San Francisco District, with assistance from staff with the NMFS West Coast Region (as available), will assist in oversight of projects that are authorized each year under the Program. This collaboration will help ensure that the limits and protection measures described in the Program are adhered to, and that databases for tracking projects, as well as any incidental take of listed species that occurs during implementation of projects authorized under the Program, is accurate and available to all three cooperating parties.

The following summarizes the anticipated process for reviewing individual project applications for consideration and authorization under the Program and the process by which projects will be administered:

1.3.5.1 Submittal of Project Applications to be Considered for Authorization under the Program

a. Many applications for salmonid habitat restoration work consistent with approved project types discussed below and included in the Program, will receive technical assistance and approval from, the RC's Community-based Restoration Program. Projects funded by various other sources must receive section 404 or section 10 permits from the Corps, and must meet all the requirements and limitations described in the Program any other measures such as terms and conditions provided in this consultation.

b. The RC website will include contact information that enables project proponents to coordinate directly with RC staff. The RC website will also include a link to the Corps-San Francisco District Regulatory Division's website, which provides instructions for the Corps' section 404 application requirements and forms for this Program (Note: The RC will coordinate closely with the Corps to ensure that it has received the project application for the appropriate section 404 permit).

1.3.5.2 Timeline for Submittals/Review

Project applications will be submitted to both the RC and the Corps – San Francisco District throughout the year and distributed to/by RC and Corps staff for review and approval.

1.3.5.3 Submittal Requirements

Project applicants seeking coverage under the Program must submit sufficient information about their project to allow the Corps and RC to determine whether or not the project qualifies for coverage. The following information will be collected by the project applicants with assistance from qualified consulting biologists and other specialized personnel. Project applicants will submit the following information either to the Corps (as part of their application for a Corps permit) or the RC (for RC-funded projects). Applicants will be responsible for obtaining any other necessary permits or authorizations from appropriate agencies before the start of project, as stated in the Biological Assessment (NOAA RC 2015a). The following information is to be submitted on the attached programmatic application form.

a. Pre-project photo monitoring data (per CDFW guidelines);

b. Project description:
   1. Project problem statement;
   2. Project goals and objectives, *etc.*;
   3. Watershed context;
   4. Description of the type of project and restoration techniques utilized (culvert replacement, instream habitat improvements, *etc.*);
   5. Project dimensions;
   6. Description of construction activities anticipated (types of equipment, timing, staging areas or access roads required):
   7. If dewatering of the work site will be necessary, description of temporary dewatering methods, including qualified individual who will be onsite to capture and transport protect salmonids;
   8. Construction start and end dates; start and end dates for salmonid relocation;
   9. Estimated number of creek crossings and type of vehicle:
   10. Materials to be used;
   11. When vegetation will be affected as a result of the project, (including removal and replacement), provide a visual assessment of dominant native shrubs and trees, approximate species diversity, and approximate acreage;
   12. Description of existing site conditions and explanation of how proposed activities improve or maintain these conditions for salmonids within expected natural variability;
   13. Description of key habitat elements (*i.e.*, temperature; type: pool, riffle, flatwater; estimate of instream shelter and shelter components; water depth; dominant substrate type, *etc.*) for salmonids in the project area.
   14. Description of applicable minimization and avoidance measures incorporated into the project (as described in *Section II. Protection Measures in the BA (NOAA RC, 2015a*).
   15. A proposed monitoring plan for the project describing how the applicant will ensure compliance with the applicable monitoring requirements described in this Program (photo monitoring, revegetation, *etc.*), including the source of funding for implementation of the monitoring plan.
   16. A checklist the applicant must sign, verifying that the applicant agrees to adhere to all project conditions and protection measures during project design and implementation.

1.3.5.4 Initial Project Screen by the Corps and RC

The RC will be the first level of review in screening potential RC-funded projects for authorization under the proposed Program. The RC will first determine whether the project's goals, techniques, location and design are consistent with the Program. Then, the RC will determine whether the project is: a) *No Effect* on ESA listed species and or critical habitat, or b) *May Affect* ESA listed species and/or designated critical habitat, and whether the proposed action comports to the conditions of the Program.

The Corps will be the first level of review in screening potential projects whose proponents are not contacted the RC but who have applied for a Corps permit and authorization under the Program. The Corps will make an affects determination for ESA listed species and critical habitat, and whether the proposed action comports to the conditions of the proposed Program. The appropriate NMFS Santa Rosa branch supervisor will be contacted as described below, prior to project approval, for the following project types: Instream Habitat Improvements (select projects), Instream Barrier Modifications (all projects), Stream Bank and Riparian Habitat Restoration (select projects), Removal of Small dams (all projects), Creation of Off-channel/Side-channel Habitat Features (all projects) and Water Conservation Projects (select projects).

1.3.5.5 Authorization of Projects and Field Checks

RC and Corps staff will utilize a pre-established checklist (called the "Application for Inclusion in the RC Santa Rosa Office Programmatic Approach") in reviewing submitted projects to determine whether the project meets the parameters of the Program. Field visits may be necessary before projects are authorized for inclusion under the Program.

Prior to the Corps or RC's approval/authorization under the Program, the Corps or the RC will contact the appropriate NMFS North-Central Coast Office Branch Chief to confirm that a project should be included in the Program. Contact will typically be by email and will include the information submitted and the response of NMFS and or California Department of Fish and Wildlife (CDFW) fish passage engineers. RC will assume a project qualifies for inclusion if it has not heard from NMFS within 2 weeks as to whether or not the project should be included in the Program. However, if the project is a stream crossing, dam removal, off-channel habitat feature, or any other fish passage project needing engineering review, RC will not move forward with the project until NMFS has finished engineering review or indicated via email that additional review is not needed. The transmittal and response emails will be maintained in each project file by RC and or the Corps.

1.3.5.6 Corps and RC Authorization and Project Construction

With the Corps' and RC's approval (and all other necessary approvals and permits obtained), authorized projects are then implemented by the applicants, incorporating all guidelines, protection measures, and additional required conditions (described in *Section 1.7 Protection Measures)*.

1.3.5.7 Post-Construction Implementation Monitoring and Reporting

Qualifying applicants will be required to carry out all post-construction implementation monitoring for projects authorized under the Program. This will include photo-documentation (using standardized guidelines for photo-documentation consistent with the pre-construction monitoring requirements); as-built designs on engineered projects; evidence that required avoidance, minimization, and mitigation measures were implemented; and information about number (and species) of fish captured and relocated, and any fish injury or mortality that resulted from the project. This information will be submitted by each applicant to the RC for data assembly. Applicants will be required to use the *Santa Rosa Office Programmatic Approach Post-Project Monitoring Form,* which will be given to applicants along with approval of the project.

1.3.5.8 Project Tracking and the Annual Report

The RC (lead agency) and Corps will work with NMFS to maintain a database that includes information on all projects implemented under the Program. In order to monitor any impacts to salmonids and critical habitat over the term of the Program, and to track any incidental take of listed salmonids, the RC (lead agency) and Corps will annually prepare and submit to NMFS a report of the previous year's restoration activities. The annual report will contain information about projects implemented during the previous construction season as well as projects that were implemented in prior years under the Program.

1.3.6 Monitoring and Reporting Requirements

All applicants will utilize standard post-construction monitoring protocols developed under the lead of CDFW. These are the same monitoring protocols CDFW follows in implementing its Fisheries Restoration Grant Program. Current instructions used by CDFW are available online at: http://ftp.dfg.ca.gov/Public/FRGP/Qualitative_Monitoring_Forms/. In addition, applicants will utilize NMFS' September 2001 (or most recent update) Guidelines for Salmonid Passage at Stream Crossings for post-construction evaluation and long-term maintenance and assessment protocols. Applicants will also be required to fill out the *Santa Rosa Office Programmatic Approach Post-Project Monitoring Form,* which will be given to applicants by the Corps or the RC when approving their project.

a. Post-construction Monitoring and Reporting Requirements:

Implementation monitoring will be conducted for all projects implemented under the proposed Program. Following construction, project applicants must submit a post-construction implementation report to the RC and the Corps. Implementation reports shall include project as-built plans and photo documentation of project implementation taken before, during, and after construction, utilizing CDFW photo monitoring protocols. For fish relocation activities, the report should include: all fisheries data collected by a qualified fisheries biologist, including the number of any salmonids killed or injured during the proposed action; the number and size (in millimeters) of any salmonids captured and removed; and any unforeseen effects of the proposed action on salmonids.

b. Annual Report

Annually, the RC and Corps will prepare a report summarizing results of projects implemented under this Program during the most recent construction season, and results of post-construction implementation and effectiveness monitoring for that year and previous years. The annual report shall include a summary of the specific type and location of each project and the ESU or DPS affected. The report shall include the following project-specific summaries:

1. Fish relocation activities, including the number and species of fish relocated and the number and species injured or killed.

2. The number and type of instream structures implemented within the stream channel.

3. The size (acres, length, and depth) of off-channel habitat features enhanced or created.

4. The length of streambank (feet) restored or planted with riparian species.

5. The number of culverts replaced or repaired, including the number of miles of restored access to salmonid habitat.

6. The size and number of dams/barriers removed, including the number of miles of restored/improved access to unoccupied salmonid habitat.

7. The distance (feet) of aquatic habitat disturbed at each project site.

8. The distance (feet) of aquatic habitat restored.

1.3.7 Protection Measures

The following protection measures, as they apply to a particular project, shall be incorporated into the project descriptions for individual projects authorized under the proposed Program.

a. General Protection Measures for All Project Types:

1. Work shall not begin until a) the RC and/or Corps has notified the permittee that the requirements of the ESA and Clean Water Act have been satisfied and that the activity is authorized and b) all other necessary permits and authorizations are finalized.

2. The general construction season shall be from June 15 to October 31. Restoration, construction, fish relocation and dewatering activities within any wetted or flowing stream channel shall occur only within this period. If precipitation sufficient to produce runoff is forecast to occur while

construction is underway, work will cease and erosion control measures will be put in place sufficient to prevent significant sediment runoff from occurring. Exceptions regarding the construction season will be considered on a case-by-case basis only if justified and if measurable precipitation sufficient to produce runoff is not forecast to occur during any of the above activities, and if approved by the RC, Corps, and NMFS. Revegetation activities including limited soil preparation outside the active channel may occur beyond October 31 if necessary to better ensure successful plant establishment during the onset of winter precipitation.

3. Prior to construction, the land manager and each contractor shall be provided with the specific protective measures to be followed during implementation of the project by the project proponent or lead biologist. In addition, a qualified biologist shall provide the construction crew with information on all listed species (including state-listed and state fully protected species) in the project area, the protection afforded the species by ESA and CESA, and guidance on those specific protection measures that must be implemented as part of the project.

4. Select herbicides such as Imazipyr may be applied to control established stands of non-native plant species. Herbicides must be applied to those species according to the registered label conditions. Herbicides must be applied directly to plants (painted or sponges) and may not be sprayed or spread upon any water. Herbicide shall be tinted with a biodegradable dye to facilitate visual control of the spray. NMFS will approve any herbicides before use. Additionally, NMFS has recently completed several consultations with the US Environmental Protection Agency (EPA) for certain herbicides. These biological opinions include RPAs that are intended to avoid and minimize adverse impacts to listed species when herbicides are applied. The protective measures identified in the RPAs must be incorporated into future labeling detailing herbicide use, or their registration for use on some crops will be cancelled by the EPA. All application instructions on the labels are requirements under the EPA, and are therefore required to be implemented under federal law when applying these herbicides.

5. Until any RPA required measures are identified on the label, the measures from the appropriate RPA, as well as proven BMPs, will be relied on for the Program in addition to current label requirements.

6. If the thalweg of the stream has been altered due to construction activities, efforts shall be undertaken to reestablish it to its original configuration. (Note: Projects that include activities such as the use of willow baffles that may alter the thalweg are allowed under the proposed Program.)

1.3.7.1 Requirements for Fish Relocation and Dewatering Activities

a. Guidelines for Dewatering:

Project activities authorized under the Program may require fish relocation and/or dewatering activities. Dewatering may not be appropriate for some projects that will result in only minor input of sediment, such as placing logs with hand crews, installing boulder clusters or felling of trees. Dewatering can result in the temporary loss of aquatic habitat, and the stranding, displacement, or crushing of fish and amphibian species. Increased turbidity may occur from disturbance of the channel bed. The following general guidelines will minimize potential impacts for projects that do require dewatering of a stream/creek.

1. In those specific cases where it is deemed necessary to dewater a work site that is located in aquatic habitat, the work area shall be isolated and all the flowing water upstream of the work site shall be temporarily diverted around the work site to maintain downstream flows during construction. Prior to dewatering, determine the best means to bypass flow through the work area to minimize disturbance to the channel and avoid direct mortality of fish and other aquatic vertebrates (as described more fully below under *General Conditions for Fish Capture and Relocation*).

2. Fish will be excluded from reentering the work area by blocking the stream channel above and below the work area with fine-meshed net or screens. Mesh will be no greater than 1/8-inch diameter. The bottom of the seine must be completely secured to the channel bed to prevent fish from reentering the work area. Exclusion screening must be placed in areas of low water velocity to minimize fish impingement. Upstream and downstream screens must be checked daily (prior to, during, and after instream activities) and cleaned of debris to permit free flow of water. Block nets shall be placed and maintained throughout the construction period at the upper and lower extent of the areas where fish will be removed. Block net mesh shall be sized to ensure salmonids upstream or downstream does not enter the areas proposed for dewatering between passes with the electro-fisher or seine.

3. Coordinate project site dewatering with a qualified biologist to perform fish and amphibian relocation activities. The qualified biologist(s) will possess all valid state and federal permits needed for fish relocation and will be familiar with the life history and identification of salmonids, state-listed fish, and listed amphibians within the action area.

4. Prior to dewatering a construction site, qualified individuals will capture and relocate fish and amphibians to avoid direct mortality and minimize take. This is especially important if listed species are present within the project site.

5. Bypass stream flow around the work area, but maintain the stream flow to channel below the construction site.

6. Minimize the length of the dewatered stream channel and duration of dewatering.

7. Any temporary dam or other artificial obstruction constructed shall only be built from materials such as sandbags or clean gravel that will cause little or no siltation. Impenetrable material shall be placed over sandbags used for construction of cofferdams construction to minimize water seepage into the construction areas. The impenetrable material shall be firmly anchored to the streambed to minimize water seepage. Cofferdams and the stream diversion systems shall remain in place and fully functional throughout the construction period.

8. When cofferdams with bypass pipes are installed, debris racks will be placed at the bypass pipe inlet. Bypass pipes will be monitored a minimum of two times per day, seven days a week, during the construction period. The contractor or project applicant shall remove all accumulated debris.

9. Bypass pipe diameter will be sized to accommodate, at a minimum, twice the existing summer baseflow.

10. The work area may need to be periodically pumped dry of seepage. Place pumps in flat areas, well away from the stream channel. Secure pumps by tying off to a tree or stake in place to prevent movement by vibration. Refuel in an area well away from the stream channel and place fuel absorbent mats under pump while refueling. Pump intakes shall be covered with appropriate sized screening material to prevent potential entrainment of fish or amphibians that failed to be removed. Check intake periodically for impingement of fish or amphibians.

11. If pumping is necessary to dewater the work site, procedures for pumped water shall include requiring a temporary siltation basin for treatment of all water prior to entering any waterway and not allowing oil or other greasy substances originating from the contractor or project applicants operations to enter or be placed where they could enter a wetted channel. Projects will adhere to currently approved CDFW and NMFS *Fish Screening Criteria* (NMFS 2011).

12. Discharge wastewater from construction area to an upland location where it will not drain sediment-laden water back to the stream channel.

13. When construction is completed, the flow diversion structure shall be removed as soon as possible in a manner that will allow flow to resume with the least disturbance to the substrate. Coffer dams will be removed so surface elevations of water impounded above the cofferdam will not be reduced at a rate greater than one inch per hour. This will minimize the risk of beaching and stranding of fish as the area upstream becomes dewatered.

b. General Conditions for all Fish Capture and Relocation Activities:

1. Fish relocation and dewatering activities shall only occur between June 15 and October 31 of each year. If precipitation sufficient to produce runoff is forecast to occur while construction is underway, work will cease and erosion control measures will be put in place sufficient to prevent significant sediment runoff from occurring. Exceptions on the fish relocation/dewatering time period will be considered on a case-by-case basis only if justified and if precipitation sufficient to produce runoff is not forecast to occur during any of the above activities, and if approved by the RC, Corps and NMFS. If the channel is expected to be seasonally dry during this period, construction should be scheduled so that fish relocation and dewatering are not necessary.

2. A qualified fisheries biologist shall perform all seining, electrofishing, and fish relocation activities. The qualified fisheries biologist shall capture and relocate salmonids and other native fish prior to construction of the water diversion structures (*e.g.,* cofferdams). The qualified fisheries biologist shall note the number of salmonids observed in the affected area, the number of salmonids relocated, and the date and time of collection and relocation. The qualified fisheries biologist shall have a minimum of three years of field experience in the identification and capture of salmonids, including juvenile salmonids. The qualified biologist will adhere to the following requirements for capture and transport of salmonids:

    a) Determine the most efficient means for capturing fish. Complex stream habitat generally requires the use of electrofishing equipment, whereas in outlet pools, fish may be concentrated by pumping down the pool and then seining or dip netting fish.

    b) Notify the RC one week prior to capture and relocation of salmonids to provide RC or NMFS staff an opportunity to attend.

    c) Initial fish relocation efforts will be conducted several days prior to the start of construction. This provides the fisheries biologist an opportunity to return to the work area and perform additional electrofishing passes immediately prior to construction if there is water in the isolated construction area. In these instances, additional fish could be captured that eluded the previous day's efforts. If water is left in the construction area, dissolved oxygen levels sufficient for salmonid survival must be maintained.

    d) At project sites with high summer water temperatures, perform relocation activities during morning periods.

    e) Prior to capturing fish, determine the most appropriate release location(s). Consider the following when selecting release site(s):

        - Similar water temperature as capture location

- Ample habitat for captured fish
- Low likelihood of fish reentering work site or becoming impinged on exclusion net or screen.

f) Periodically measure air and water temperatures and monitor captured fish. Temperatures will be measured at the head of riffle tail of pool interface. Cease activities if health of fish is compromised owing to high water temperatures, or if mortality exceeds three percent of captured salmonids.

c. Electrofishing Guidelines:

The following methods shall be used if fish are relocated via electrofishing:

1. All electrofishing will be conducted according to NMFS' *Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act* (NMFS 2000).

2. The backpack electro-fisher shall be set as follows when capturing fish: Voltage setting on the electro-fisher shall not exceed 300 volts.

	Initial	Maximum
A) Voltage:	100 Volts	300 Volts
B) Duration:	500 µs (microseconds)	5 ms (milliseconds)
C) Frequency:	30 Hertz	30 Hertz

3. A minimum of three passes with the electro-fisher shall be utilized to ensure maximum capture probability of salmonids within the area proposed for dewatering.

4. Water temperature, dissolved oxygen, and conductivity shall be recorded in an electrofishing log book, along with electrofishing settings.

5. A minimum of one assistant shall aid the fisheries biologist by netting stunned fish and other aquatic vertebrates.

d. Seining Guidelines:

The following methods shall be used if fish are removed with seines.

1. A minimum of three passes with the seine shall be utilized to ensure maximum capture probability of all salmonids within the area.

2. All captured fish shall be processed and released prior to each subsequent pass with the seine.

3. The seine mesh shall be adequately sized to ensure fish are not gilled during capture and relocation activities.

e. Guidelines for Relocation of Salmonids:

The following methods shall be used during relocation activities associated with either method of capture (electrofishing or seining):

1. Fish shall not be overcrowded into buckets, allowing no more than 150 0+ fish (approximately six cubic inches per 0+ individuals) per 5 gallon bucket and fewer individuals per bucket for larger/older fish.

2. Every effort shall be made not to mix 0+ salmonids with larger steelhead, or other potential predators, that may consume the smaller salmonids. Have at least two containers and segregate young-of-year (0+) fish from larger age-classes. Place larger amphibians in the container with larger fish.

3. Salmonid predators, including other fishes and amphibians, collected and relocated during electrofishing or seining activities shall not be relocated so as to concentrate them in one area. Particular emphasis shall be placed on avoiding relocation of predators into the salmonid relocation pools. To minimize predation of salmonids, these species shall be distributed throughout the wetted portion of the stream to avoid concentrating them in one area.

4. All captured salmonids shall be relocated, preferably upstream, of the proposed construction project and placed in suitable habitat. Captured fish shall be placed into a pool, preferably with a depth of greater than two feet with available instream cover.

5. All captured salmonids will be processed and released prior to conducting a subsequent electrofishing or seining pass.

6. All native captured fish will be allowed to recover from electrofishing before being returned to the stream.

7. Minimize handling of salmonids. However, when handling is necessary, always wet hands or nets prior to touching fish. Handlers will not wear insect repellants containing the chemical N,N-Diethyl-meta-toluamide (DEET).

8. Temporarily hold fish in cool, shaded, aerated water in a container with a lid. Provide aeration with a battery-powered external bubbler. Protect fish from jostling and noise and do not remove fish from this container until time of release.

9. Place a thermometer in holding containers and, if necessary, periodically conduct partial water changes to maintain a stable water temperature. If water temperature reaches or exceeds those allowed by CDFW and NMFS, fish shall

be released and rescue operations ceased.

10. In areas where aquatic vertebrates are abundant, periodically cease capture, and release at predetermined locations.

11. Visually identify species and estimate year-classes of fish at time of release. Count and record the number of fish captured. Avoid anesthetizing or measuring fish. Also identify hatchery (clipped adipose fin) and wild fish.

12. If more than 3 percent of the salmonids captured are killed or injured, the project permittee shall contact the RC (currently Joe Pecharich (707) 575-6095 or at joe.pecharich@noaa.gov). The RC will then contact NMFS within 24 hours.

13. The purpose of the contact is to review the activities resulting in take and to determine if additional protective measures are required. All salmonid mortalities must be retained, placed in an appropriately sized, zip-sealed bag, labeled with the date and time of collection, fork length, location of capture, and frozen as soon as possible. Frozen samples must be retained until specific instructions are provided by NMFS.

1.3.7.2 Measures to Minimize Disturbance from Instream Construction

Measures to minimize disturbance associated with instream habitat restoration construction activities are presented below. Measures are excerpted from *Measures to Minimize Disturbance from Construction,* on page IX-50 of the CDFW Manual:

a. Construction will occur between June 15 and October 31. Revegetation activities, including soil preparation, may extend beyond October 31, if necessary, to better ensure successful plant establishment during the onset of winter precipitation. If precipitation greater than one inch is forecast during the June 15 – October 31 work window, the RC must be notified, implementation work must stop, and erosion control BMP's must be implemented. Extensions of this work window will be considered on a case-by-case basis only if justified and if precipitation sufficient to produce runoff is not forecast to occur during any of the above activities, the effects of this action are not outside the effects analyzed in the BA, and if approved by the RC, Corps and NMFS.

b. Debris, soil, silt, excessive bark, rubbish, creosote-treated wood, raw cement/ concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to aquatic life, resulting from projected related activities, shall be prevented from contaminating the soil and/or entering the waters of the State. Any of these materials, placed within or where they may enter a stream or lake, by the applicant or any party working under contract, or with permission of the applicant, shall be removed immediately. During project activities, all trash that may attract potential predators of salmonids will be properly contained, removed from the work site, and disposed of daily.

c. Where feasible, the construction shall occur from the bank, or on a temporary pad underlain with filter fabric.

d. No heavy equipment will enter wetted channels.

e. Use of heavy equipment shall be avoided in a channel bottom with rocky or cobbled substrate. If access to the work site requires crossing a rocky or cobbled substrate, a rubber tire loader/backhoe is the preferred vehicle. Only after this option has been determined infeasible will the use of tracked vehicles be considered. The amount of time this equipment is stationed, working, or traveling within the creek bed shall be minimized. When heavy equipment is used, woody debris and vegetation on banks and in the channel shall not be disturbed if outside of the project's scope.

f. The use or storage of petroleum-powered equipment shall be accomplished in a manner to prevent the potential release of petroleum materials into waters of the state (Fish and Game Code 5650).

g. Areas for fuel storage, refueling, and servicing of construction equipment must be located in an upland location.

h. Prior to use, clean all equipment to remove external oil, grease, dirt, or mud. Wash sites must be located in upland locations so wash water does not flow into the stream channel or adjacent wetlands.

i. All construction equipment must be in good working condition, showing no signs of fuel or oil leaks. Prior to construction, all mechanical equipment shall be thoroughly inspected and evaluated for the potential of fluid leakage. All questionable motor oil, coolant, transmission fluid, and hydraulic fluid hoses, fitting, and seals shall be replaced. The contractor shall document in writing all hoses, fittings, and seals replaced and shall keep this documentation until the completion of operations. All mechanical equipment shall be inspected on a daily basis to ensure there is no motor oil, transmission fluid, hydraulic fluid, or coolant leaks. All leaks shall be repaired in the equipment staging area or other suitable location prior to resumption of construction activity.

j. Oil absorbent and spill containment materials shall be located on site when mechanical equipment is in operation with 100 feet of the proposed watercourse crossings. If a spill occurs, no additional work shall commence in-channel until (1) the mechanical equipment is inspected by the contractor, and the leak has been repaired, (2) the spill has been contained, and (3) NMFS and CDFW are contacted and have evaluated the impacts of the spill.

1.3.7.3 Measures to Minimize Degradation of Water Quality

Construction or maintenance activities for the projects proposed under this Program may result in temporary increases in turbidity levels in the stream. In general, these activities must not result in significant, or long term increases in turbidity levels beyond the naturally occurring, background conditions. The following measures shall be implemented to reduce the potential for impacts to water quality during and post-construction:

a. General Erosion Control during Construction:

1. When appropriate, isolate the construction area from flowing water until project materials are installed and erosion protection is in place.

2. Effective erosion control measures shall be in place at all times during construction. Do not start construction until all temporary control devices (straw bales with sterile, weed free straw, silt fences, *etc.)* are in place downslope or downstream of project site within the riparian area. The devices shall be properly installed at all location where the likelihood of sediment input exists. These devices shall be in place during and after construction activities for the purposes of minimizing fine sediment and sediment/water slurry input to flowing water and of detaining sediment-laden water on site. If continued erosion is likely to occur after construction is completed, then appropriate erosion prevention measures shall be implemented and maintained until erosion has subsided. Erosion control devices such as coir rolls or erosion control blankets will not contain plastic netting of a mesh size that would entrain, fish, reptiles or amphibians.

3. Sediment shall be removed from sediment controls once it has reached one-third of the exposed height of the control. Whenever straw bales are used, they shall be staked and dug into the ground to a minimum depth of 12 cm, and only sterile, weed-free straw shall be utilized.

4. Sediment-laden water created by construction activity shall be filtered before it leaves the right-of-way or enters the stream network or an aquatic resource area.

5. The contractor/project applicant is required to inspect and repair/maintain all practices prior to and after any storm event, at 24-hour intervals during extended storm events, and a minimum of every two weeks until all erosion control measures have been completed.

b. Guidelines for Temporary Stockpiling:

1. Minimize temporary stockpiling of material. Stockpile excavated material in areas where it cannot enter the stream channel. Prior to start of construction; determine if such sites are available at or near the project location. If nearby sites are unavailable, determine location where material will be deposited. Establish locations to deposit spoils well away from watercourses with the potential to delivery sediment into the stream network draining into current salmonid habitat, or historically supporting populations of salmonids. Spoils shall be contoured to disperse runoff and stabilized with mulch and (native) vegetation. Use devices such as plastic sheeting held down with rocks or

sandbags over stockpiles, silt fences, or berms of hay bales, to minimize movement of exposed or stockpiled soils.

2. If feasible, conserve topsoil for reuse at project location or use in other areas. End-haul spoils away from watercourses as soon as possible to minimize potential sediment delivery.

c. Minimizing Potential for Scour:

1. When needed, utilize instream boulder grade control structures to control channel scour, sediment routing, and headwall cutting.

2. For relief culverts or structures, if a pipe or structure that empties into a stream is installed, an energy dissipater shall be installed to reduce bed and bank scour. This does not apply to culverts installed in fish-bearing tributaries.

3. The toe of rock slope protection used for streambank stabilization shall be placed below bed scour to ensure stability.

d. Post-Construction Erosion Control:

1. Immediately after project completion and before close of seasonal work window, stabilize all exposed soil with mulch, seeding, and/or placement of erosion control blankets. Remove all artificial erosion control devices after the project area has fully stabilized. All exposed soil present in and around the project site shall be stabilized within 7 days. Erosion control devices such as coir rolls or erosion control blankets will not contain plastic netting of a mesh size that would entrain reptiles and amphibians.

2. All bare and/or disturbed slopes (larger than 10’ x 10’ of bare mineral soil) will be treated with erosion control methods such as straw mulching, netting, fiber rolls, and hydro-seed as permanent erosion control measures.

3. Where straw, mulch, or slash is used as erosion control on bare mineral soil, the minimum coverage shall be 95% with a minimum depth of two inches.

4. When seeding is used as an erosion control measure, only natives will be used. Sterile (without seeds), weed-free straw, free of exotic weeds, is required when hay bales are used as an erosion control measure.

1.3.7.4 Measures to Minimize Loss or Disturbance of Riparian Vegetation

Measures to minimize loss or disturbance to riparian vegetation are described below. The revegetation and success criteria that will be adhered to for projects implemented under the proposed Program that result in disturbance to riparian vegetation are also described below.

a. Minimizing Disturbance:

1. Retain as many trees and shrubs as feasible, emphasizing shade-producing and bank-stabilizing trees and brush.

2. Prior to construction, determine locations and equipment access points that minimize riparian disturbance. Pre-existing access points shall be used whenever possible. Avoid entering unstable areas, which may increase the risk of channel instability.

3. Minimize soil compaction by using equipment with a greater reach or that exerts less pressure per square inch on the ground, resulting in less overall area disturbed or less compaction of disturbed areas.

4. If riparian vegetation is to be removed with chainsaws, consider using saws currently available that operate with vegetable-based bar oil.

b. Revegetation and Success Criteria:

1. Any stream bank area left barren of vegetation as a result of the implementation or maintenance of the practices shall be restored to a natural state by seeding, replanting, or other agreed upon means with native trees, shrubs, and/or grasses. Barren areas shall typically be planted with a combination of willow stakes, native shrubs and trees and/or erosion control grass mixes.

2. Native plant species shall be used for revegetation of disturbed and compacted areas. The species used shall be specific to the project vicinity or the region where the project is located, and comprise a diverse community structure (plantings shall include both woody and herbaceous species).

3. For projects where re-vegetation is implemented to compensate for riparian vegetation impacted by project construction, a re-vegetation monitoring report will be required after 2 years to document success. Success is defined as 80% survival of plantings or 80% ground cover for broadcast planting of seed after a period of 2 years. If revegetation efforts will be passive (*i.e.*, natural regeneration), success will be defined as total cover of woody and herbaceous material equal to or greater than pre-project conditions. If at the end of 2 years, the vegetation has not successfully been re-established, the applicant will be responsible for replacement planting, additional watering, weeding, invasive exotic eradication, or any other practice, to achieve these requirements. If success is not achieved within the first 2 years, the project applicant will need to prepare a follow-up report in an additional year's time.

4. All plastic exclusion netting placed around plantings will be removed and recycled after 3 years, or earlier if appropriate.

1.3.7.5 Measures to Minimize Impacts from Road-related Restoration Projects

Road modification, repair and decommissioning activities are considered to be one project regardless of the number of individual work sites or the different techniques employed at each site.

Upon the completion of restoration activities, roads within the riparian zone affected by construction activities shall be weather proofed according to measures described in the *Handbook for Forest and Ranch Roads* by Weaver and Hagans (1994, revised 2014) of Pacific Watershed Associates and in Part X of the CDFW Manual, "*Upslope Assessment and Restoration Practices.*" Following are some of the methods that may be applied to non-surfaced roads impacted by project activities implemented under the proposed Program:

a. Establish waterbreaks (*e.g.*, waterbars and rolling dips) on all seasonal roads, skid trails, paths, and firebreaks by November 30. Do not remove waterbreaks until May 15.

b. Maximum distance for waterbreaks shall not exceed the following standards; (1) for road or trail gradients less than 10%: 100 feet; (2) for road or trail gradients 11-25%: 75 feet; (3) for road or trail gradients 26% or greater: 50 feet. Depending on site-specific conditions, more frequent intervals may be required to prevent road surface erosion.

c. Locate waterbreaks to allow water to be discharged onto some form of vegetative cover, slash, rocks, or less erodible material. Do not discharge waterbreaks onto unconsolidated fill.

d. Waterbreaks shall be cut diagonally a minimum of 6 inches into the firm roadbed, skid trail, or firebreak surface and shall have a continuous firm embankment of at least 6 inches in height immediately adjacent to the lower edge of the waterbreak cut.

e. The maintenance period for waterbreaks and any other erosion control facilities shall occur after every major storm event for the first year after installation.

f. Rolling-dips are preferred over waterbars. Waterbars shall only be used on unsurfaced roads where winter use (including use by bikes, horses, and hikers) will not occur.

g. After the first year of installation, erosion control facilities shall be inspected prior to the beginning of the winter period (October 31), after the first major storm event, and prior to the end of the winter period (May 15).

h. Applicant will establish locations to deposit spoils well away from watercourses with the potential to delivery sediment into streams supporting, or historically supporting populations of salmonids. Spoils shall be contoured to disperse runoff and stabilized with mulch and (native) vegetation.

i. No berms are allowed on the outside of the road edge.

j. No herbicides shall be used on vegetation on inside ditches.

1.3.7.6 Measures to Minimize Impacts from Small Dam Removal

a. Projects will be deemed ineligible for the Program if: 1) sediments stored behind dam have a reasonable potential to contain environmental contaminants [dioxins, chlorinated pesticides, polychlorinated biphenyls (PCBs), or mercury] beyond the freshwater probable effect levels (PELs) summarized in the NOAA Office of Response and Restoration's Screening Quick Reference Table guidelines, or 2) the risk of significant loss or degradation of downstream spawning or rearing areas by sediment deposition is considered by RC and NMFS or CDFW engineers to be such that the project requires more detailed analysis. Sites shall be considered to have a reasonable potential to contain contaminants of concern if they are downstream of historical contamination sources such as lumber or paper mills, industrial sites, or intensive agricultural production going back several decades (since chlorinated pesticides were legal to purchase and use). In these cases, preliminary sediment sampling is advisable.

b. All construction will take place out of the wetted channel either by implementing the project from the bank and out of the channel or by constructing cofferdams, relocating aquatic species found within the project reach, and dewatering the channel. No more than 250 linear feet (125 feet on each side of the channel) of riparian vegetation will be disturbed for project access. All disturbed areas will be re-vegetated with native grasses, trees, or shrubs appropriate for the site.

c. Project applicants are required to provide project designs to RC technical monitors prior to project approval and implementation. A NMFS or CDFW engineer will be given the chance to review and comment on all project designs and decide level of review. Data requirements and analysis to be provided with dam removal project design should attempt to meet NMFS 2011 Anadromous Salmonid Passage Facility Design (NMFS 2011 Guidelines). If proposed project designs do not meet the NMFS 2011 Guidelines, a variance may be explored and granted at the discretion of RC and NMFS engineers if there is a clear benefit to fish passage. Applicants will be required to implement the RC Fish Passage Barrier Removal Performance Measures and Monitoring Worksheet (Fish Passage Barrier Removal Worksheet can be found at: http://www.habitat.noaa.gov/toolkits/restoration_center_toolkits/forms_and_guidance_documents/ori_monitoring_sheet_w_guidance.pdf) that includes regionally appropriate fish passage criteria for fish passage projects, and which have been incorporated into the data needs described below.

d. Data and Analysis Requirements:
Minimal and Potential Data Needs: Listed below are the minimal and potential data needs for conducting any small dam removal project. However, site

specific conditions may require additional information beyond what is identified here to adequately evaluate a small dam removal project. Similarly, unanticipated complications in a project such as the need to use a roughened channel and/or other fish passage techniques to pass fish over buried infrastructure (*e.g.,* gas, water, and sewer lines) will require additional data. The minimal data needed to conduct simpler small dam projects along with the potential data needs for more complex projects is listed in the project description section above.

1) Minimal Data Needs:

   A) A clear statement of the fish passage objectives of the project. Objectives shall be explicitly stated for any small dam removal project (*e.g.,* to improve fish passage, improve sediment continuity and downstream spawning habitat, and/or to provide passage meeting specific fish passage guidelines).

   B) A clear statement and justification for the project's method of restoring the channel along with a sediment management plan.

   C) The proposed time-frame for dam and sediment removal along with the time expected for channel equilibrium to occur at the project site. Include anticipated and actual start and end dates of project.

   D) The distance and location of nearest upstream grade control feature (natural or anthropogenic).

   E) An estimate of depth and volume of sediment stored above the dam. Evidence that the amount of sediment to be released above the dam is relatively small and unlikely to significantly affect downstream spawning, rearing, and/or over-summering habitats. The estimate should be determined with a minimum of five cross-sections - one downstream of the structure, three through the reservoir area upstream of the structure, and one upstream of the reservoir area outside of the influence of the structure - to characterize the channel morphology and quantify the stored sediment.

   F) Detailed information on project/reference reach including:
      1. Location of project/reference reach.
      2. Channel width (baseline and target range in feet): Should be determined by taking three measurements of active channel at the dam and immediately upstream and downstream of the dam.
      3. Any existing geomorphic features present and that will be incorporated into the channel (*e.g.* pools, riffles, runs, step-pools, *etc.*).
      4. Overall channel slope (% baseline and target): determined by taking a longitudinal profile throughout the project reach upstream

and downstream to the extent of dam influence on the channel slope.

5. Maximum channel slope: determined through the site before and after the project using pre-project and as-built (post-project) longitudinal profiles.
6. Photographs of pre and post project conditions, illustrating implementation of the dam removal, upstream sediment deposit/reservoir, and channel morphology upstream and downstream of the proposed project reach.
7. Maximum jump height (baseline and target range in inches): using the pre-project and/or as built longitudinal profile to determine the maximum height a fish would have to jump to migrate through the site.
8. A longitudinal profile of the stream channel thalweg for at least 20 channel widths upstream and downstream (pre and post project) of the structure or of a sufficient distance to establish the natural channel grade, whichever is greater, shall be used to determine the potential for channel degradation (as described in the CDFW Manual).
9. The number of stream miles opened by each project should be estimated before implementation and verified after project completion. The following sources may be used to verify the number of upstream miles made accessible as a result of the project: exiting aerial photos and maps of the project watershed, local or regional barrier databases, existing staff or local expert knowledge of project watershed, and/or field verification (in cases where there is permission to access the stream).
10. A survey of any downstream spawning areas that may be negatively affected by sediment released by removal of the dam.
11. Presence/absence of salmonids:
    <u>Pre-implementation:</u> Use one of the following survey techniques defined in California Coastal Salmonid Population Monitoring: Strategy, Design, and Methods (Adams *et al.* 2011) to identify and report presence/absence for either adults or juveniles upstream of the project site. Describe the survey techniques used to determine presence/absence status of salmonids. If a pre-implementation survey is not possible, report whether the barrier is a known full barrier or partial barrier for salmonids. Describe any pre-project data that is available. If no recent, biological information is available, include surrogate information (*e.g.* most recent observation of species above barrier, description of "completeness" of barrier, *etc.*).
    <u>Post-implementation:</u> If the pre-implementation status was determined to be "absent," use one of the survey techniques to identify and report presence/absence following implementation. If pre-project upstream status was determined to be “present” (*e.g.* partial barriers), report any change in presence/absence following implementation if possible. In this case, the post-implementation

result may be “continued presence." Describe the methodology used to determine presence/absence for the target fish species. Frequency /duration of sampling: The timing and frequency should correlate with the life history of the target fish species. At a minimum, if landowner access is allowed, this parameter should be monitored one time following implementation, and if funding and landowner access allows, would preferably be monitored on an annual or seasonal basis. Monitoring for this measure is likely to yield meaningful results in the first 3 years after project implementation, although in some situations it may be valuable to monitor for the first 5 years. Optional monitoring: for partial barriers or projects where the pre-implementation fish presence/absence status was identified as "present," the proportional change in the number of adults or juveniles due to project implementation may be measured.

2) Potential data needs for more complex projects:

NMFS engineers and/or the RC lead may request additional information from more complex projects to include:

A) Hydraulic modeling immediately upstream and downstream of the project site, and throughout the project reach.

B) Sediment modeling immediately upstream and downstream of the project site, and throughout the reach of the stream in which the project is located, including: Sediment grain size distribution within the dam depositional area and the sediment grain size distributions of the channel bed material within the equilibrium reaches upstream and downstream of the dam; recurrence interval of the discharge needed to mobilize the sediment particles and any established vegetation within the sediment deposit upstream of the dam that is to be removed; and bed and bank grain size distributions.

C) Detailed geomorphic assessment of the watershed and/or stream reach.

D) Detailed hydrologic analysis of the watershed and how it will drive the geomorphic conditions within the watershed before and after dam removal.

E) A detailed assessment of the habitat conditions within the watershed and/or upstream and downstream of the reach of the stream in which the project is located.

e. Two conditions that may preclude a project from eligibility for coverage under the Program are: 1) if sediments stored behind dam have a reasonable potential to contain environmental contaminants (may include but not limited to: dioxins, chlorinated pesticides, polychlorinated biphenyls (PCBs), or mercury) beyond the freshwater probable effect levels (PELs) summarized in the NOAA Screening Quick Reference Table guidelines found at: http://response.restoration.noaa.gov/book_shelf/122_NEW-SQuiRTs.pdf, or 2) if the risk of significant loss or degradation of downstream spawning or rearing areas by sediment deposition is considered to be such that the project requires more detailed analysis. Sites should be considered to have a reasonable potential to contain contaminants of concern if they are downstream of historical contamination sources such as industrial sites, or sites where intensive agricultural production going back several decades occurred (since chlorinated pesticides were legal to purchase and use for many years). In these cases, preliminary sediment sampling is advisable for a project to be considered for coverage under the proposed Program.

1.3.8 Specific Requirements for Off-channel Habitat Projects

Restoring off-channel habitat features is a relatively new restoration technique in California and the lessons learned through monitoring these features will provide valuable information for adaptive management and future projects. All off-channel habitat projects included in this Program will require an additional level of physical and biological monitoring. Project applicants will collect the following information with assistance from qualified consulting biologists, and submit the information to the RC and Corps:

a. Pre- and post-project photo monitoring data (per CDFW guidelines);

b. Project Description:
    1. Project problem statement
    2. Project goals and objectives, *etc.*
    3. Watershed context
    4. Description of the type of off-channel feature and restoration techniques utilized
    5. Project dimensions
    6. Description of outlet control feature (if present)
    7. If dewatering of the work site will be necessary, description of temporary dewatering methods including qualified individual who will be onsite to transport protected steelhead
    8. Construction start and end dates
    9. Materials to be used
    10. When vegetation will be affected as a result of the project (including removal and replacement), provide a visual assessment of dominant native shrubs and trees, approximate species diversity, and approximate acreage
    11. Description of existing site conditions and explanation of how proposed activities improve or maintain these conditions for salmonids, within the range of natural variability expected at the site
    12. Description of key habitat elements (*i.e.*, temperature; type: pool, riffle, flatwater; estimate of instream shelter and shelter components; water depth; dominant substrate type, *etc.*) for salmonids in the project area
    13. Pre- and post-construction (after winter flow event) information on the elevation of the inlet and outlet structure relative to the 2-year flood event

14. A description of if and when the off-channel feature became disconnected from the main channel. This will require checking the project site daily when the off-channel feature is becoming disconnected from the main channel.
15. A description of any stranded fish observed. If salmonids are stranded, the applicant will contact NMFS and RC staff immediately to determine if a fish rescue action is necessary. CDFW may also be contacted and provided with fish rescue information and/or mortalities by species.

1.4 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 includes all stream channels, riparian areas, and hydrologically linked upslope areas that will be affected by the implementation of the proposed restoration projects that are authorized under the Program. Qualifying restoration projects occurring within the NMFS North- Central Coastal California Office boundaries will be implemented under the Program (Figure 1). Because restoration projects could potentially occur within any stream within ESUs and DPSs located in Figure 1, the action area includes all coastal anadromous streams and estuaries (excluding the San Francisco Bay) from San Luis Obispo County (Salinas River and tributaries) north to, but not including, the Mattole River.

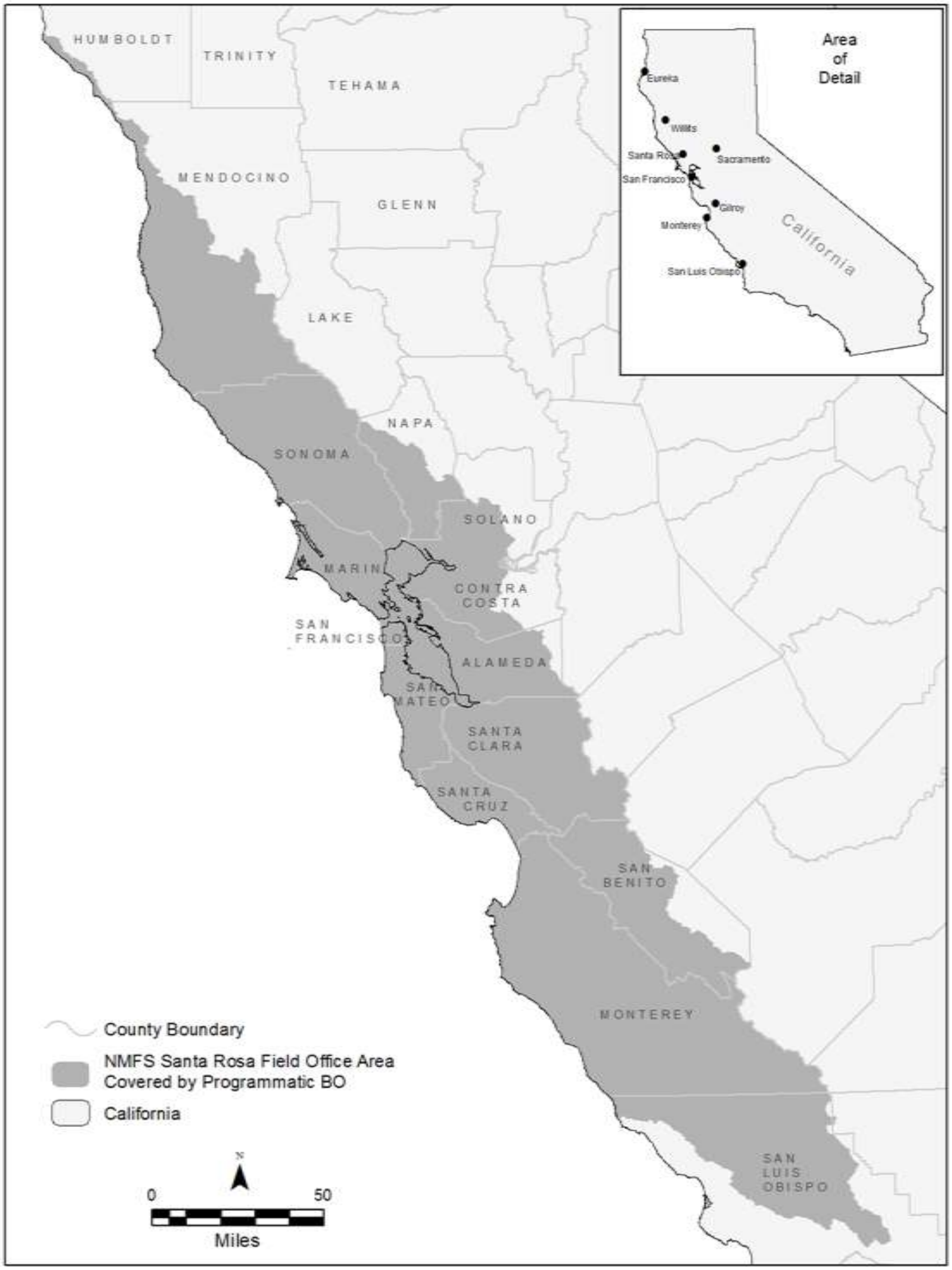

Figure1. Map showing the action area included in the proposed RC and Corps restoration program. Action area does not include the San Francisco Bay.

2. ENDANGERED SPECIES ACT (ESA): 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, Federal agencies must ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitat. If incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures 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 "to jeopardize the continued existence of a listed species," which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

The adverse modification analysis considers the impacts of the Federal action on the conservation value of designated critical habitat. This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (81 FR 7214).[1]

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

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

[1] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

- Reach jeopardy and adverse modification conclusions.
- If necessary, define a reasonable and prudent alternative to the proposed action.

2.2 Life History and Range-wide Status of the Species and Critical Habitat

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

This biological opinion analyzes the effects of the action on the following listed salmonids and their designated critical habitat:

- **Endangered CCC coho salmon (*Oncorhynchus kisutch)* Evolutionarily Significant Unit (ESU)**
  Listing determination (70 FR 37160; June 28, 2005)
  Critical habitat designation (64 FR 24049; May 5, 1999);

- **Threatened CC Chinook salmon (*O. tshawytscha)* ESU**
  Listing determination (70 FR 37160; June 28, 2005)
  Critical habitat designation (70 FR 52488; September 2, 2005);

- **Threatened CCC steelhead (*O. mykiss*) Distinct Population Segment (DPS)**
  Listing determination (71 FR 834; January 5, 2006)
  Critical habitat designation (70 FR 52488; September 2, 2005);

- **Threatened NC steelhead (*O. mykiss)* Distinct Population Segment (DPS)**
  Listing determination (71 FR 834; January 5, 2006)
  Critical habitat designation (70 FR 52488; September 2, 2005);

- **Threatened S-CCC steelhead (*O. mykiss*) Distinct Population Segment (DPS)**
  Listing determination (62 FR 43937; August 18, 1997)
  Critical habitat designation (70 FR 52488; September 2, 2005).

2.2.1 Species Description and Life History

Coho Salmon

The life history of coho salmon in California has been well documented by Shapovalov and Taft (1954) and Hassler (1987). 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 coho salmon typically begin the freshwater migration from the ocean to their natal streams after heavy late fall or winter rains breach the sandbars at the mouths of coastal streams (Sandercock 1991). Delays in river entry of over a month are not unusual (Salo and Bayliff 1958, Eames *et al.* 1981). Migration continues into March, generally peaking in December and January, with spawning occurring shortly after arrival to the spawning ground (Shapovalov and Taft 1954).

Coho salmon are typically associated with medium to small 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.

Female coho salmon choose spawning areas usually near the head of a riffle, just below a pool, where water changes from a laminar to a turbulent flow and small to medium gravel substrate are present. The flow characteristics surrounding the redd usually ensure good aeration of eggs and embryos, and flushing of waste products. The water circulation in these areas also facilitates fry emergence from the gravel. Preferred spawning grounds have: nearby overhead and submerged cover for holding adults; water depth of 4 to 21 inches; water velocities of 8 to 30 inches per second; clean, loosely compacted gravel (0.5 to 5 inch diameter) with less than 20 percent fine silt or sand content; cool water ranging from 39 to 50 degrees Fahrenheit (°F) with high dissolved oxygen of 8 mg/L; and inter-gravel flow sufficient to aerate the eggs. Lack of suitable gravel often limits successful spawning.

Each female builds a series of redds, moving upstream as she does so, and deposits a few hundred eggs in each. Fecundity of female coho salmon is directly proportional to size; each adult female coho salmon may deposit from 1,000 to 7,600 eggs (Sandercock 1991). Briggs (1953) noted a dominant male accompanies a female during spawning, but one or more subordinate males may also engage in spawning. Coho salmon may spawn in more than one redd and with more than one partner (Sandercock 1991). Coho salmon are semelparous meaning they die after spawning. The female may guard a redd for up to two weeks (Briggs 1953).

The eggs generally hatch after four to eight weeks, depending on water temperature. Survival and development rates depend on temperature and dissolved oxygen levels within the redd. According to Baker and Reynolds (1986), 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. McMahon (1983) found that egg and fry survival drops sharply when fine sediment makes 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). Chapman and Bjornn (1969) determined that larger parr tend to occupy the head of pools, with smaller parr found further down the pools. As the fish continue to grow, they move into deeper water and expand their territories until, by July and August; they reside exclusively in deep pool habitat. Juvenile coho salmon prefer: well shaded pools at least 3.3 feet deep with dense overhead cover, abundant submerged cover (undercut banks, logs, roots, and other woody debris); water temperatures of 54° to 59° F

(Brett 1952, Reiser and Bjornn 1979), but not exceeding 73° to 77° F (Brungs and Jones 1977) for extended time periods; dissolved oxygen levels of 4 to 9 mg/L; and water velocities of 3.5 to 9.5 inches per second in pools and 12 to 18 inches per second in riffles. Water temperatures for good survival and growth of juvenile coho salmon range from 50° to 59° F (Bell 1973, McMahon 1983). Growth is slowed considerably at 64° F and ceases at 68° F (Stein *et al.* 1972, Bell 1973).

Preferred rearing habitat has little or no turbidity and high sustained invertebrate forage production. Juvenile coho salmon feed primarily on drifting terrestrial insects, much of which are produced in the riparian canopy, and on aquatic invertebrates growing within the interstices of the substrate and in leaf litter in pools. As water temperatures decrease in the fall and winter months, fish stop or reduce feeding due to lack of food or in response to the colder water, and growth rates slow. During December through February, winter rains result in increased stream flows. By March, following peak flows, fish resume feeding on insects and crustaceans, and grow rapidly.

In the spring, as yearlings, juvenile coho salmon undergo a physiological process, or smoltification, which prepares them for living in the marine environment. They begin to migrate downstream to the ocean during late March and early April, and out-migration usually peaks in mid-May, if conditions are favorable. Emigration timing is correlated with 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). At this point, the smolts are about four to five inches in length. After entering the ocean, the immature salmon initially remain in nearshore waters close to their parent stream. They gradually move northward, staying over the continental shelf (Brown *et al.* 1994). Although they can range widely in the north Pacific, movements of coho salmon from California are poorly understood.

Chinook salmon

Chinook salmon return to freshwater to spawn when they are three to eight years old (Healey 1991). Some Chinook salmon return from the ocean to spawn one or more years before they reach full adult size, and are referred to as jacks (males) and jills (females). Chinook salmon runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and actual time of spawning (Myers *et al.* 1998). Both winter-run and spring-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. For comparison, fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991).

Fall-run CC Chinook salmon migrate upstream during June through November, with peak migration periods occurring in September and October. Spawning occurs from late September through December, with peaks in late October. Adequate instream flows and cool water temperatures are more critical for the survival of spring-run Chinook salmon (compared to fall-run or winter-run Chinook salmon) due to over-summering by adults and/or juveniles. Chinook salmon generally spawn in gravel beds that are located at the tails of holding pools (Bjornn and Reiser 1991). Adult female Chinook salmon prepare redds in stream areas with suitable gravel composition, water depth, and velocity. Optimal spawning temperatures range between 42° to 57° F. Redds vary widely in size and location within the river. Preferred spawning substrate is clean, loose gravel, mostly sized between 1 and 10 cm, with no more than 5 percent fine sediment. Gravels are unsuitable when they have been cemented with clay or fine particles or when sediments settle out onto redds, reducing inter-gravel percolation (62 FR 24588). Minimum inter-gravel percolation rate depends on flow rate, water depth, and water quality. The percolation rate must be adequate to maintain oxygen delivery to the eggs and remove metabolic wastes. Chinook salmon require a strong, constant level of subsurface flow, as a result, suitable spawning habitat is more limited in most rivers than superficial observation would suggest. After depositing eggs in redds, most adult Chinook salmon guard the redd from 4 to 25 days before dying.

Chinook salmon eggs incubate for 90 to 150 days, depending on water temperature. Successful incubation depends on several factors including dissolved oxygen levels, temperature, substrate size, amount of fine sediment, and water velocity. Maximum survival of incubating eggs and pre-emergent fry occurs at water temperatures between 42° and 56° F with a preferred temperature of 52° F. CC Chinook salmon fry emerge from redds during December through mid-April (Leidy and Leidy 1984).

After emergence, Chinook salmon fry seek out areas behind fallen trees, back eddies, undercut banks, and other areas of bank cover (Everest and Chapman 1972). As they grow larger, their habitat preferences change. Juveniles move away from stream margins and begin to use deeper water areas with slightly faster water velocities, but continue to use available cover to minimize predation risk and reduce energy expenditure. Fish size appears to be positively correlated with water velocity and depth (Chapman and Bjornn 1969, Everest and Chapman 1972). Optimal temperatures for both Chinook salmon fry and fingerlings range from 54° to 57° F, with maximum growth rates at 55° F (Boles 1988). Chinook salmon feed on small terrestrial and aquatic insects and aquatic crustaceans. Cover, in the form of rocks, submerged aquatic vegetation, logs, riparian vegetation, and undercut banks provide food, shade, and protect juveniles from predation. CC Chinook salmon will rear in freshwater for a few months and outmigrate during April through July (Myers *et al.* 1998).

Steelhead

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. 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 is correlated with higher flow events, such as freshets or sandbar breaches. Adult summer steelhead migrate upstream from March through September. 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 (CDFG) 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 (CDFG 2001).

Survival to emergence of steelhead embryos is inversely related to the proportion of fine sediment in the spawning gravels. However, steelhead are slightly more tolerant than other salmonids, with significantly reduced survival when fine materials of less than 0.25 inches in diameter comprise 20 to 25 percent of the substrate. Fry typically emerge from the gravel two to three weeks after hatching (Barnhart 1986).

Upon emerging from the gravel, fry rear in edgewater habitats and move gradually into pools and riffles as they grow larger. Older fry establish territories which they defend. Cover is an important habitat component for juvenile steelhead, both as a velocity refuge and as a means of avoiding predation (Meehan and Bjornn 1991). Steelhead, however, tend to use riffles and other habitats not strongly associated with cover during summer rearing more than other salmonids. Young steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. In winter, juvenile steelhead become less active and hide in available cover, including gravel or woody debris.

Water temperature can influence the metabolic rate, distribution, abundance, and swimming ability of rearing juvenile steelhead (Barnhart 1986, Bjornn and Reiser 1991, Myrick and Cech 2005). Optimal temperatures for steelhead growth range between 50° and 68° F (Hokanson *et al.* 1977, Wurtsbaugh and Davis 1977, Myrick and Cech 2005). Variability in the diurnal water temperature range is also important for the survivability and growth of salmonids (Busby *et al.* 1996).

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 Species and Critical Habitat

In this biological opinion, NMFS assesses four population viability parameters to help us understand the status of each species and their ability to survive and recover. These population viability parameters are: abundance, population growth rate, special structure, and diversity (McElhaney *et al.* 2000). While there is insufficient information to evaluate these population viability parameters in a thorough quantitative sense, NMFS has used existing information, including the NOAA Fisheries' Recovery Plan for the Evolutionary Significant Unit of Central California Coast Coho salmon (NMFS 2012) and NOAA Fisheries' Coastal Multispecies Recovery Plan Public draft (NMFS 2015), to determine the general condition of each population and factors responsible for the current status of each DPS or ESU.

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

CCC Coho Salmon

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 1940's, which declined to about 100,000 fish by the 1960's, followed by a further decline to about 31,000 fish by 1991. More recent abundance estimates vary from approximately 600 to 5,500 adults (NMFS 2005). Recent status reviews (NMFS 2003, NMFS 2005, Williams *et al.* 2011) indicate that the CCC coho salmon are likely continuing to decline in number. CCC coho salmon have also experienced acute range restriction and fragmentation. Adams *et al.* (1999) found that in the mid 1990's, coho salmon were present in 51 percent (98 of 191) of the streams where they were historically present, 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 in progress by both the NMFS Southwest Fisheries Science Center (SWFSC) and the Bodega Marine Laboratory has documented reduced genetic diversity within CCC coho salmon subpopulations (Bjorkstedt *et al.* 2005). The influence of hatchery fish on wild stocks has also contributed to the poor diversity through outbreeding depression and disease.

Available data from the few remaining independent populations shows continuing declines and many independent populations that 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 substantial decline in the Russian River coho salmon abundance led to the formation of the Russian River Coho Salmon Captive Broodstock Program (RRCSCBP) in 2001. Under this program, offspring of wild captive-reared coho salmon are released as juveniles into tributaries within their historic range with the expectation that some of them will return as adults to naturally reproduce. Juvenile coho salmon and coho salmon smolts have been released into several tributaries within the lower Russian River and Dry Creek watersheds.

Williams *et al.* (2011), in the most recent SWFSC status update, note that for all available time series, recent population trends have been downward with particularly poor adult returns from 2006 to 2010. In addition, any independent populations are well below low-risk abundance targets and several are either extinct or below the high-risk dispensation thresholds that were identified by Spence *et al.* (2008). It appears that none of the five diversity strata defined by Bjorkstedt *et al.* (2005) currently support viable populations based on criteria established by Spence et al (2008). The risk of extinction for this ESU appears to have increased since the last formal review when Good *et al.* (2005) concluded that the ESU was in danger of extinction. The best available updated information on the biological status of this ESU and the threats facing this ESU (Williams *et al.* 2011, NMFS 2011a, Spence 2016) indicate that it continues to remain endangered, and its condition is worsening (76 FR 50447). Based on this information, NMFS chose to maintain the endangered listing of CCC coho salmon (Williams 2016).

The 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; residential and commercial development; and severe weather. The impacts of these major threats are described in the effects to critical habitat section.

CC Chinook salmon

The CC Chinook salmon ESU was historically comprised of approximately 32 Chinook salmon populations (Bjorkstedt *et al.* 2005). Many of these populations (about 14) were independent, or potentially independent, meaning they had a high likelihood of surviving for 100 years absent anthropogenic impacts. The remaining populations were likely more dependent upon immigration from nearby independent populations than dependent populations of other salmonids (Bjorkstedt *et al.* 2005).

Data on CC Chinook abundance, both historical and current, is sparse and of varying quality (Bjorkstedt *et al.* 2005). Estimates of absolute abundance are not available for populations in this ESU (Myers *et al.* 1998). In 1965, CDFG (1965) estimated escapement for this ESU at over 76,000. Most were in the Eel River (55,500), with smaller populations in Redwood Creek (5,000), Mad River (5,000), Mattole River (5,000), Russian River (500) and several smaller streams in Humboldt County (Myers *et al.* 1998). Currently available data indicate abundance is far lower, suggesting an inability to sustain production adequate to maintain the ESU′s populations.

CC Chinook salmon populations remain widely distributed throughout much of the ESU. Notable exceptions include the area between the Navarro River and Russian River and the area between the Mattole and Ten Mile River populations (Lost Coast area). The lack of Chinook salmon populations both north and south of the Russian River (the Russian River is at the southern end of the species' range) makes it one of the most isolated populations in the ESU. Myers *et al.* (1998) reports no viable populations of Chinook salmon south of San Francisco, California.

Because of their prized status in the sport and commercial fishing industries, CC Chinook salmon have been the subject of many artificial production efforts, including out-of-basin and out-of-ESU stock transfers (Bjorkstedt *et al.* 2005). It is therefore likely that CC Chinook salmon genetic diversity has been significantly adversely affected despite the relatively wide population distribution within the ESU. An apparent loss of the spring-run Chinook life history in the Eel River Basin and elsewhere in the ESU also indicates risks to the diversity of the ESU.

Data from the 2009 adult CC Chinook salmon return counts and estimates indicated a further decline in returning adults across the range of CC Chinook salmon on the coast of California (Jeffrey Jahn, NMFS, personal communication 2010). Ocean conditions are suspected as the principal short term cause because of the wide geographic range of declines (SWFSC 2008). However, the number of adult CC Chinook salmon returns in the Russian River Watershed increased substantially in 2010/2011 compared to 2008/09 and 2009/10 returns[2]. Increases in adult Chinook salmon returns during 2010/2011 have been observed in the Central Valley populations as well.

Using an updated analysis approach, Williams *et al.* (2011) did not find evidence of a substantial change in conditions since the last status review (Good *et al.* 2005). Williams *et al.* (2011) found that the loss of representation from one diversity stratum, the loss of the spring-run history type in two diversity substrata, and the diminished connectivity between populations in the northern and southern half of the ESU pose a concern regarding viability for this ESU. Based on consideration of this updated information, Williams *et al.* (2011) concluded the extinction risk of the CC Chinook salmon ESU has not changed since the last status review. On August 15, 2011, NMFS affirmed no change to the determination that the CC Chinook salmon ESU is a threatened species, as previously listed (NMFS 2011b, 76 FR 50447). The latest status review of this CC Chinook salmon determined that there is no change in the extinction risk for this ESU (Spence 2016).

The NMFS's recovery plan (NMFS 2015) for the CC Chinook salmon ESU identified the major threats to recovery. These major threats include: channel modification, roads, logging and timber harvesting; water diversions and impoundments; and severe weather. The impacts of these major threats are described in the effects to critical habitat section.

CCC Steelhead

Historically, approximately 70 populations[3] of steelhead existed in the CCC steelhead DPS (Spence *et al.* 2008). Many of these populations (about 37) were independent, or potentially

[2] http://www.SCWA.ca.gov/chinook/

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

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-1960's, including 50,000 fish in the Russian River – the largest population within the DPS (Busby *et al.* 1996). Near the end of the 20th century, McEwan (2001) estimated that the wild steelhead population in the Russian River watershed was between 1,700 and 7,000 fish. Abundance estimates for smaller coastal streams in the DPS indicate low but stable levels, with recent estimates for several streams (Lagunitas, Waddell, Scott, San Vicente, Soquel, and Aptos creeks) of individual run sizes of 500 fish or less (62 FR 43937).

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 habitat fragmentation has likely also led to loss of genetic diversity in these populations. For more detailed information on trends in CCC steelhead abundance, see: Busby *et al.* 1996, NMFS 1997, Good *et al.* 2005, and Spence *et al.* 2008.

CCC steelhead have experienced serious declines in abundance and long-term population trends suggest a negative growth rate. This indicates the DPSs may not be viable in the long term. DPS populations that historically provided enough steelhead immigrants to support dependent populations may no longer be able to do so, placing dependent populations at increased risk of extirpation. However, because CCC steelhead have maintained a wide distribution throughout the DPS, roughly approximating the known historical distribution, CCC steelhead likely possess a resilience that is likely to slow their decline relative to other salmonid DPSs or ESUs in worse condition. The 2005 status review concludes that steelhead in the CCC steelhead DPS remain "likely to become endangered in the foreseeable future" (Good *et al.* 2005), a conclusion that was consistent with a previous assessment (Busby *et al.* 1996) and supported by the most recent NMFS Technical Recovery Team work (Spence *et al.* 2008). On January 5, 2006, NMFS issued a final determination that the CCC steelhead DPS is a threatened species, as previously listed (71 FR 834). Although numbers did not decline further during 2007/08, the 2008/09 adult CCC steelhead return data indicated a decline in returning adults across their range. Escapement data from 2009/2010 indicated a slight increase; however, the returns were still well below data observed within recent decades (Jeffrey Jahn, personal communication, 2010).

The most recent status review by the Williams *et al.* (2011) concludes that steelhead in the CCC steelhead DPS remain "likely to become endangered in the foreseeable future" (Williams *et al.* 2011), as new and additional information available since Good *et al.* (2005) does not appear to suggest a change in extinction risk. On December 7, 2011, NMFS affirmed no change to the determination that the CCC steelhead DPS is a threatened species, as previously listed (NMFS 2011c, 76 FR 76386). In the most recent status review, Williams (2016) found that there is little evidence to suggest that the extinction risk for this DPS has changed appreciably in either direction since the publication of the last viability assessment

(Williams *et al.* 2011).

The NMFS's recovery plan (NMFS 2015) for the CCC steelhead DPS identified the major threats to recovery. These major threats include: channel modification, residential and commercial development; roads, and water diversions and impoundments. The impacts of these major threats are described in the effects to critical habitat section.

NC Steelhead

Historically, the NC steelhead DPS was comprised of 41 independent populations (19 functionally and 22 potentially independent) of winter run steelhead and 10 functionally independent populations of summer run steelhead (Bjorkstedt *et al.* 2005). Based on the limited data available (dam counts of portions of stocks in several rivers), NMFS' initial status review of NC steelhead (Busby *et al.* 1996) determined that population abundance was very low relative to historical estimates (1930s and 1960s dam counts), and recent trends were downward in most stocks. Overall, population numbers are severely reduced from pre-1960s levels, when approximately 198,000 adult steelhead migrated upstream to spawn in the major rivers supporting this Distinct Population Segment (DPS) (Busby *et al.* 1996, 65 FR 36074).

Updated status reviews reach the same conclusion, and noted the poor amount of data available, especially for winter run steelhead (NMFS 1997, Good *et al.* 2005). The information available suggests that the population growth rate is negative. Comprehensive geographic distribution information is not available for this DPS, but steelhead are considered to remain widely distributed (NMFS 1997). It is known that dams on the Mad River and Eel River block large amounts of habitat historically used by NC steelhead (Busby *et al.* 1996). Hatchery practices in this DPS have exposed the wild population to genetic introgression and the potential for deleterious interactions between native stock and introduced steelhead. Historical hatchery practices at the Mad River hatchery are of particular concern, and included out-planting of non-native Mad River hatchery fish to other streams in the DPS and the production of non-native summer steelhead (65 FR 36074). The conclusion of the most recent status review (Good *et al.* 2005) echoes that of previous reviews. Abundance and productivity in this DPS are of most concern, relative to NC steelhead spatial structure (distribution on the landscape) and diversity (level of genetic introgression). The lack of data available also remains a risk because of uncertainty regarding the condition of some stream populations.

NMFS evaluated the listing status of NC steelhead and proposed maintaining the threatened listing determination (71 FR 834) in 2006. The most recent status review by Williams *et al.* (2011) reports a mixture of patterns in population trend information, with more populations showing declines than increases. Although little information is available to assess the status for most population in the NC steelhead DPS, overall Williams *et al.* (2011) found little evidence to suggest a change in status compared to the last status review by Goode *et al.* (2005). The most recent status review by Williams (2016) reports that available information for winter-run and summer-run populations of NC steelhead do not suggest an appreciable increase or decrease in extinction risk since publication of the last viability assessment (Williams *et al.* 2011).

SCCC Steelhead

Populations of SCCC steelhead throughout the DPS have exhibited a long-term negative trend since at least the mid-1960s. In the mid-1960s, total spawning population was estimated at 17,750 individuals (Goode *et al.* 2005). Available information shows SCCC steelhead population abundance continued to decline from the 1970s to the 1990s (Busby *et al.* 1996) and more recent data indicate this trend continues (Good *et al.* 2005). Current SCCC steelhead run- sizes in the five largest river systems in the DPS (Pajaro River, Salinas River, Carmel River, Little Sur River, and Big Sur River) are likely reduced from 4,750 adults in 1965 (CDFG 1965) to less than 500 returning adult fish in 1996. More recent estimates for total run-size do not exist for the SCCC steelhead DPS (Goode *et al.* 2005) as few comprehensive or population monitoring programs are in place.

Recent analyses conducted by the SCCC steelhead Technical Review Team (TRT) indicate the SCCC steelhead DPS consists of 12 discrete sub-populations representing localized groups of interbreeding individuals, and none of these sub-populations currently meet the definition of viable (Boughton *et al.* 2006; Boughton *et al.* 2007). Most of these sub-populations are characterized by low population abundance, variable or negative population growth rates, and reduced spatial structure and diversity. The sub-populations in the Pajaro River and Salinas River[4] watersheds are in particularly poor condition (relative to watershed size) and exhibit a greater lack of viability than many of the coastal populations.

Although steelhead are present in most of the streams in the SCCC DPS (Good *et al.* 2005), their populations are small, fragmented, and unstable (more subject to stochastic events) (Boughton *et al.* 2006). In addition, severe habitat degradation and the compromised genetic integrity of the some populations pose a serious risk to the survival and recovery of the SCCC steelhead DPS (Good *et al.* 2005). During the winter of 2010/11, adult returns appeared to rebound toward the numbers seen at the beginning of the decade. This is largely based on a significant in adult returns counted at the San Clemente Dam on the Carmel River[5], and a notable increase in the number of observed adults in Uvas Creek in the Pajaro Watershed. However, these increases in the adult returns have not persisted in the most recent years due to onset and continuation of drought conditions that have impacted the region since the winter of 2011/12. This is evident by the much reduced numbers of juvenile steelhead captured and adults observed at sites in Corralitos Creek (Alley 2015) and Uvas Creeks (Casagrande 2014, 2015), in the neighboring Salinas river where flows have not reached the lagoon, or the ocean, since 2013, and in the Carmel River where only 7 adults were counted at the San Clemente fish ladder during the winter of 2014-15.

In the most recent status update, NMFS concluded there was no evidence to suggest the status of the SCCC steelhead DPS has changed appreciably since the publication of the previous status review (Goode *et al.* 2005), and therefore, SCCC steelhead remain listed as threatened (Williams *et al.* 2011). The most recent status review (Williams 2016) concludes

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[4] The TRT only identified multiple populations in the Salinas River system for the purposes of DPS viability analysis. However, for the purposes of the threat analysis (and corresponding recovery actions), the Pajaro River was broken into the Uvas Creek tributary and the remainder of the Pajaro River system (which includes the mainstem and other tributaries). Uvas Creek was singled out because of its importance and the large number of threats.

[5] http://www.mpwmd.dst.ca.us/fishcounter/fishcounter.htm

that this DPS is one of eight steelhead DPS's that show no appreciable change since the last status review.

<u>CCC, NC, & SCCC steelhead, CC Chinook salmon, and CCC coho salmon critical habitat</u>

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

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

PBFs for CCC, NC, S-CCC steelhead and CC Chinook salmon critical habitat, and their associated essential features within freshwater include:

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

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, CC Chinook salmon, and CCC, NC, S-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[6]: 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). Diversion and storage of river and stream flow has dramatically altered the natural hydrologic cycle in many of the streams within the ESU. Altered flow regimes can delay or preclude migration, dewater aquatic habitat, and strand fish in disconnected pools, while unscreened diversions can entrain juvenile fish.

2.2.3 Additional Threats to CC Chinook salmon, CCC Coho Salmon, CCC, NC, S-CCC Steelhead and their critical habitat

Global climate change presents an additional potential threat to salmonids and their critical habitats. Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level have all increased in California over the last century (Kadir *et al.* 2013). Snow melt from the Sierra Nevada Mountains has declined (Kadir *et al.* 2013). However, total annual precipitation amounts have shown no discernable change (Kadir *et al.* 2013). Listed salmonids 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.

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

For Northern California, most models project heavier and warmer precipitation. Extreme wet and dry periods are projected, increasing the risk of both flooding and droughts (DWR 2013). Estimates show that snowmelt contribution to runoff in the Sacramento/San Joaquin Delta

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[6] Other factors, such as over fishing and artificial propagation, have also contributed to the current population status of these species. All these human induced factors have exacerbated the adverse effects of natural environmental variability from such factors as drought and poor ocean conditions.

may decrease by about 20 percent per decade over the next century (Cloern *et al.* 2011). Many of these changes are likely to further degrade listed salmonid habitat by, for example, reducing streamflows during the summer and raising summer water temperatures. Estuaries may also experience changes detrimental to salmonids. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia *et al.* 2002, Ruggiero *et al.* 2010). In marine environments, ecosystems and habitats important to juvenile and adult salmonids are likely to experience changes in temperatures, circulation, water chemistry, and food supplies (Brewer and Barry 2008; Feely 2004; Osgood 2008; Turley 2008; Abdul-Aziz *et al.* 2011; Doney *et al.* 2012). The projections described above are for the mid to late 21st Century. In shorter time frames, climate conditions not caused by the human addition of carbon dioxide to the atmosphere are more likely to predominate (Cox and Stephenson 2007).

2.3 Environmental Baseline

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

The action area includes all coastal anadromous California streams south of the Mattole River in Humboldt/Mendocino County south to headwaters of the Salinas River in San Luis Obispo County and all streams draining into San Francisco and San Pablo bays eastward to the Napa River (inclusive), excluding the Sacramento-San Joaquin River Basin (Figure 1).

The action area encompasses approximately 15,000 square miles of the central and northern California Coast Range. Native vegetation varies from redwood (*Sequoia sempervirens*) forest along the lower drainages to Douglas fir (*Pseudotsuga menziesii*) intermixed with hardwoods and chaparral, to ponderosa pine (*Pinus ponderosa*) and Jeffery pine (*Pinus jefferyi*) stands along the upper elevations. Areas of grasslands are also found along the main ridge tops and south facing slopes of the watersheds.

The action area has a Mediterranean climate characterized by cool wet winters with typically high runoff, and dry warm summers characterized by greatly reduced instream flows. Fog is a dominant climatic feature along the coast, generally occurring daily in the summer and not infrequently throughout the year. Higher elevations and inland areas tend to be relatively fog free. Most precipitation falls during the winter and early spring as rain, with occasional snow above 1,600 ft. Along the coast, average air temperatures range from 46E to 56E Fahrenheit (F). Further inland and in the southern part of the action area, annual air temperatures are much more varied, ranging from below freezing in winter to over 100EF during the summer months.

High seasonal rainfall on bedrock and other geologic units with relatively low permeability, erodible soils, and steep slopes contribute to the flashy nature (stream flows rise and fall quickly) of the watersheds within the action area. In addition, these high natural runoff rates have been increased by road systems, urbanization, and other land uses. High seasonal rainfall combined with rapid runoff rates on unstable soils delivers large amounts of sediment to river systems. As a result, many river systems within the action area contain a relatively large sediment load, typically deposited throughout the lower gradient reaches of these systems.

2.3.1 Status of the Species and/or Critical Habitat in the Action Area

This section provides a synopsis of the four geographic areas of consideration, the ESUs/DPSs and HUCs present within each area, specific recent information on the status of coho salmon or steelhead, and a summary of the factors affecting the listed species within the action area. The best information presently available demonstrates that a multitude of factors, past and present, have contributed to the decline of west coast salmonids (Weitkamp *et al.* 1995, Busby *et al.* 1996, NMFS 1996, Myers *et al.* 1998, NMFS 1998, CDFG 2002, CRWQCB 2001). The following is a summary of the factors affecting the environment of the species or critical habitat within each HUC. Information in this section is delineated by the following geographic areas: North Central Coast Area, San Francisco Bay Area, and the Central Coast Area, and subdivided by 4th Field HUCs.

The discussion of information from the North Central Coast, San Francisco Bay, and Central Coast areas are organized by HUCs. A few HUCs in these areas contain one river system, but most contain several small systems.

2.3.1.1 North Central Coast Area

The North Central Coast area includes all coastal California streams entering the Pacific Ocean in Mendocino, Sonoma, and Marin counties, excluding streams draining into San Francisco and San Pablo bays. The North Central Coast Area includes portions of three ESUs/DPSs (CCC coho salmon, NC steelhead, and CCC steelhead) and five USGS 4th field HUCs (Big-Navarro-Garcia, Bodega Bay, Gualala-Salmon, Russian, and Tomales-Drakes Bay). Forestry is the dominant land-use throughout the northern part of this area (north of the Russian River). Agriculture and urbanization are more predominant in the Russian River and areas south.

a. Big, Navarro, and Garcia River

This HUC-8 includes all coastal watersheds from Jackass Creek south to, but not including, the Gualala River. This HUC is wholly within Mendocino County and includes most of the coastal streams in the county. There are several medium-sized watersheds present within the HUC: Garcia River, Navarro River, Albion River, Big River, Noyo River, and Ten Mile River. The HUC also includes many smaller watersheds draining directly to the Pacific Ocean. The urban development within the HUC is limited primarily to coastal towns on the estuaries of the larger streams, though there are some small towns in other areas of the HUC. In the larger basins within this HUC, private forest lands average about 75 percent of the total acreage (65 FR 36074). Forestry is the dominant land use activity; in some subwatersheds, significant portions (up to 100 percent) have been harvested (CRWQCB 2001). Excessive sedimentation, low LWD abundance and recruitment, and elevated water temperature are issues throughout the HUC; these issues are largely attributable to forestry activities (NMFS 2015). Agriculture has likely contributed to depressed habitat conditions within the Navarro River watershed, and gravel mining may affect salmonids in the Ten Mile and Garcia River watersheds. The effects of land use activities are exacerbated by the naturally erosive geology, the mountainous and rugged terrain, and legacy impacts from historically large storms (*e.g.,* 1964, 1982). Estuaries throughout the HUC have likely decreased in size due to sedimentation and flood control actions (*e.g.*, diking and channelization). All of the larger watersheds within this HUC are included on the 2012 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012), and have TMDLs in place that address sediment pollution.

This HUC is within the CCC coho salmon ESU, CC Chinook salmon ESU, and NC steelhead DPS. Salmonid abundance has declined throughout the HUC. Steelhead are widespread yet reduced in abundance, and coho salmon have a patchy distribution with populations significantly reduced from historic levels (Weitkamp *et al.* 1995; Busby *et al.* 1996; CRWQCB 2001). The most recent status review noted positive but non-significant population trends for coho salmon within the Ten Mile River, Big River, and Albion River over the last several years, but overall, but most populations remain below or near depensation levels (Williams 2016). Small numbers of Chinook salmon continue to appear within the Ten Mile, Noyo and Big rivers, although these numbers remain well below depensation thresholds for each population (Williams 2016). Recent estimates of NC steelhead abundance within the North-Central Coast Stratum have generally improved during the past several years; yet similar to Chinook and coho salmon, many of these steelhead populations remain at or below population depensation levels. On a positive note, both the Big River and Ten Mile River populations have experienced positive growth trends during the past six years (Williams 2016). Likewise, Garcia River steelhead escapement has averaged 326 adults annually for the past 6 years, and the population trend is also positive (although insignificantly so).

b. Gualala-Salmon River

This HUC-8 includes the entire Gualala River watershed and all coastal watersheds between the Gualala River watershed and the Russian River watershed. The Gualala River is the only large watershed within the HUC, though there are several small coastal watersheds. There is limited urban development within the HUC. Within the Gualala River watershed, private forest lands make up about 94 percent of the total acreage, and forestry is the dominant land use of the watershed (65 FR 36074). Agriculture has been a significant land use within the Gualala River watershed; historically orchards and grazing were the dominant agricultural activities, though more recently vineyard development and illicit marijuana cultivation has become more common within the basin (NMFS 2014). Gravel mining is largely a historic activity, although a rather large gravel mining operation near the confluence of the Wheatfield Fork remains (Matt Goldsworth, personal communication). Gravel extraction is currently limited to 40,000 tons per year, though extractions in the past 10 years have not reached that limit (CRWQCB 2001). The Gualala River is included on the 2012 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012). The pollution factors for the Gualala River are sedimentation, temperature, DO, and a host of chemical pollutants; forestry, agriculture, and land development are listed as the potential sources for those factors (CSWRCB 2012). In 2001, a TMDL for sediment was approved for the Gualala River (www.epa.gov).

This HUC contains CCC coho salmon, CC Chinook salmon and NC steelhead. Higgins *et* *al.* (1992) considered coho salmon from the Gualala River as being at a high risk of extinction. The CDFG (2002) concluded that the Gualala River contains no known remaining viable coho salmon populations; no population data exists from the past 5 years, and NMFS suspects the number of coho salmon in the Gualala River is very low (SWFSC 2016). Recent steelhead data suggests the Gualala River may contain the largest remaining steelhead population within the CCC DPS (Williams 2016). Three small coastal watersheds within this HUC and outside the Gualala River watershed, historically contained coho salmon: Fort Ross Creek, Russian Gulch, and Scotty Creek (Brown and Moyle 1991; Hassler *et al.* 1991).

c. Russian River

This HUC-8 contains the entire Russian River basin and no other watersheds. Portions of the HUC are in Sonoma and Mendocino counties. There is significant urban development within this HUC centered on the Highway 101 corridor, though there are small towns and rural residences throughout the HUC. Santa Rosa is the largest city within the HUC. Forestry and agriculture are other significant land uses within the HUC, and there are some in-channel gravel mining operations. Brown and Moyle (1991) reported that logging and mining in combination with naturally erosive geology have led to significant aggradation of up to 10 feet in some areas of Austin Creek - a lower Russian River tributary. NMFS's status reviews (Weitkamp *et al.* 1995; Busby *et al.* 1996; Myers *et al.* 1998) identified two large dams within the Russian River that block access to anadromous fish habitat: Coyote Valley Dam and Warm Springs Dam. Steiner Environmental Consulting (SEC) (1996) cite unpublished data from the California State Water Resources Control Board (CSWRCB), which state that there are over 500 small dams on the Russian River and its tributaries. These dams have a variety of functions including residential, commercial, and agricultural water supply, flood and/or debris control, and recreation. These small dams interfere with fish migration, affect sediment transport, and affect water flow and temperature.

The Corps (1982) concluded that the loss of tributary habitat was the primary factor limiting the recovery of the anadromous fishery in the Russian River. The Russian River is included on the 2013 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2013). The pollution factors for the Russian River are vary by sub-watershed, but commonly include sediment, temperature, dissolved oxygen, various nutrients, and many chemical pollutants and pathogens. Forestry, agriculture, dams with flow regulation, urban and land development, and nonpoint sources are listed as the potential sources for these factors. Lake Sonoma, a reservoir impounded by Warm Springs Dam, is included on the section 303(d) list because of elevated levels of mercury associated with historic mining. Currently, there is no approved TMDL for the Russian River watershed (www.epa.gov).

Many releases of in-basin and out-of-basin Chinook salmon, coho salmon and steelhead occurred throughout the Russian River since the late 1800s (Weitkamp *et al.* 1995; Busby *et al.* 1996; Myers *et al.* 1998; NMFS 1999a). For the last 20 years, the Don Clausen Fish Hatchery operated at Warm Springs Dam and released coho salmon, Chinook salmon, and steelhead into the Russian River watershed. However, significant changes in hatchery operations began in 1998, in which the production of coho salmon and Chinook salmon was discontinued. Traditional production of steelhead continues at Don Clausen Fish

Hatchery.

This HUC is within the CCC coho salmon ESU, CC Chinook salmon ESU, and CCC steelhead DPS. The CDFG (2002) reported that recent monitoring data indicate that widespread extirpation of coho salmon has occurred within the Russian River basin. In 2001, a conservation hatchery program was developed for coho salmon at the Don Clausen Fish Hatchery. Juvenile coho salmon from the program have been released for reintroduction into several historical coho salmon Russian River tributaries annually beginning in Fall 2004. Recent monitoring data indicate the coho salmon population in the lower Russian River (Dry Creek downstream, inclusive) ranged from 206 to 536 adult fish during the past four years (Williams 2016). The Russian River population of Chinook salmon has shown no discernable trend in population abundance during the past 14-year period, with an average annual escapement counted at the Mirabell counting facility of 3,257 fish (Williams 2016). The lack of adequate spawner surveys within the Russian River precludes the estimation of wild steelhead escapement within the basin; however, hatchery returns suggest the vast majority of returning fish are of hatchery origin. Current population abundance for all three species remains a mere fraction of their target recovery levels.

d. Bodega Bay

This HUC-8 contains all of the coastal watersheds from the Estero de San Antonio north to the mouth of the Russian River. There are three moderate-sized watersheds within the HUC (Salmon Creek, Americano Creek, and Stemple Creek) and few small coastal watersheds directly tributary to the Pacific Ocean. The Salmon Creek watershed is wholly within Sonoma County, whereas the Americano Creek and Stemple Creek watersheds are in both Sonoma and Marin counties. There is limited urban development within the HUC; agriculture is the dominant land use within all of the watersheds within this HUC, with dairy farming being the primary activity. There are some forest lands in the headwaters of Salmon Creek. Large winter storms have exacerbated the impact of land use activities and natural erosive geology of Salmon Creek (Brown and Moyle 1991) and negatively affected rearing habitat quality and quantity. Americano Creek and Stemple Creek and their estuaries are included on the 2012 Clean Water Act section 303(d) list of water quality limited segments for elevated levels of nutrients and sediment (CSWRCB 2012). The pollution factors for these streams are sedimentation, nutrients, invasive species, and temperature; Diazinon is listed as a pollutant in Estero de San Antonio. Agriculture and land development are listed as the potential sources for those factors. Many of the streams lack riparian cover, causing increased water temperatures.

This HUC is within the CCC coho salmon ESU and CCC steelhead DPS. The distribution and abundance of salmonids within the HUC are highly reduced. Within this HUC, coho salmon have been found in two watersheds: Salmon Creek and Valley Ford Creek (Brown and Moyle 1991; Hassler *et al.* 1991; Weitkamp *et al.* 1995). Excess coho salmon broodstock fish from Warm Springs Hatchery have been released into Salmon Creek during the past several years in an attempt to re-establish a self-sustaining run within the watershed (Williams 2016). NMFS found no historical coho salmon collections from watersheds of this HUC between Valley Ford Creek and Tomales Bay. The watersheds of this HUC historically contained steelhead. Steelhead are found throughout Salmon Creek, but the status of steelhead distribution in tributary streams is unknown. Steelhead are likely extirpated from San Antonio Creek and Americano Creek (Cox 2004).

e. Tomales-Drakes Bay

This HUC-8 includes all watersheds draining into the Pacific Ocean from Rodeo Cove north to Tomales Bay. The entire HUC is in Marin County, with the exception of a small portion of the headwaters of Walker Creek, which is in Sonoma County. Most of the watersheds in this HUC are small with the exception of Walker Creek and Lagunitas Creek, both tributaries of Tomales Bay, a prominent artifact of the San Andreas Rift Zone. Urban development within the HUC ranges from single homes to small towns and municipal complexes. Although urbanization has been limited, flood control activities, contaminated runoff from paved lots and roads, and seepage from improperly designed and/or maintained septic systems, continue to impact habitat and water quality in portions of the watershed (Ketcham 2003). Recreation is a significant factor in land use within the HUC as there are county, state, and Federal parks within the HUC. Agriculture is a dominant land-use, particularly in the northern half of the HUC, and forestry was a historic land use activity within the HUC. Lagunitas Creek, Walker Creek, and Tomales Bay are included on the 2002 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012); nutrients, pathogens, and sedimentation are the factors and are attributed to agriculture and urban runoff or storm sewers. Mercury, associated with mining, is an additional factor for Walker Creek and Tomales Bay. The construction of Kent Reservoir and Nicasio Reservoir cut off 50 percent of the historical salmonid habitat within the Lagunitas Creek watershed; and construction of two large reservoirs within the Walker Creek watershed, Laguna Lake, and Soulejoule Reservoir, cut off access to significant amounts of habitat (Weitkamp *et al.* 1995; Busby *et al.* 1996; Myers *et al.* 1998, CDFG 2002, NMFS 2015). Sedimentation has had a profound effect on fish habitat in Walker Creek. Many of the deep, cool pools and gravel that salmonids depend on for spawning and rearing, have been filled in with fine sediment.

Elevated stream temperatures are also a concern within many watersheds throughout the HUC. Summer water temperatures are usually below lethal thresholds for salmonids, but can be high enough to retard growth. It was reported that juvenile salmonids in Lagunitas Creek did not show appreciable growth during the summer of 1984, and it is believed that this lack of growth was due to the relatively high summer water temperatures that occurred during this time (Bratovich and Kelly 1988). The National Park Service has documented water temperatures well over the preferred range for salmonids in Olema Creek and one of its tributaries (Ketcham 2003).

This HUC is within the CCC coho salmon ESU and CCC steelhead DPS. With the exception of Lagunitas Creek, the abundance of coho salmon is very low throughout the HUC. Lagunitas Creek may have the largest populations of coho salmon remaining in the CCC coho salmon ESU. Although Lagunitas Creek is presumed to have a relatively stable and healthy population of coho salmon, at least when compared with other CCC coho salmon streams, NMFS (2001) noted that this stream has experienced a recent reduction in coho salmon abundance. Small persistent populations of coho salmon are in Pine Gulch Creek and Redwood Creek. Anecdotal evidence of a once thriving coho salmon and steelhead run in Walker Creek exists. Yet the species was thought to be extirpated from the watersheds of this HUC by both Adams *et al.* (1999) and CDFG (2002) as recently as fifteen years ago. In an attempt to increase population spatial distribution, excess coho salmon broodstock from Warm Spring hatchery were introduced into Walker Creek from 2008-2014, and observations of juvenile coho salmon following those plantings indicate successful spawning by those released broodstock fish (Spence 2016).. Small numbers of Chinook salmon are often encountered within Lagunitas Creek, which is outside the current CC ESU boundary that ends at the Russian River. NMFS is currently considering extending the CC ESU boundary to include these fish (Williams 2016).

2.3.1.2 San Francisco Bay Area

The San Francisco Bay Area encompasses the region between the Golden Gate Bridge and the confluence of the San Joaquin and Sacramento rivers. All of the watersheds in this area drain into San Francisco Bay, San Pablo Bay, or Suisun Bay at Chipps Island. Watersheds within this area are in portions of several counties: Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, San Mateo, and San Francisco. This area contains four HUC-8s (4th field HUCs): San Pablo Bay, Suisun Bay, San Francisco Bay, and Coyote. Anthropogenic factors affecting listed salmonids in these HUCs are related primarily to urbanization, though agriculture is another prevalent land use in the San Pablo Bay and Suisun HUCs. Urban development is extensive within this area and has negatively affected the quality and quantity of salmonid habitat. Human population within the San Francisco Bay Area is approximately six million, representing the fourth most populous metropolitan area in the United States, and continued growth is expected (www.census.gov). In the past 150 years, the diking and filling of tidal marshes has decreased the surface area of the greater San Francisco Bay by 37 percent. More than 500,000 acres of the estuary's historic tidal wetlands have been converted for farm, salt pond, and urban uses (San Francisco Estuary Project 1992). These changes have diminished tidal marsh habitat, increased pollutant loadings to the estuary, and degraded shoreline habitat due to the installation of docks, shipping wharves, marinas, and miles of rock riprap for erosion protection. Most tributary streams have lost habitat through channelization, riparian vegetation removal, water development, and reduced water quality. Dams blocking anadromy are present on many streams and are used for water supply, aquifer recharge, or recreational activities. Streams have been affected by surface water diversion and groundwater withdrawal. Channelization for flood control, roadway construction, and commercial/ residential development have further affected the quality and quantity of available salmonid habitat. Most watersheds within this area are listed under the 2012 Clean Water Act section 303(d) list of impaired water bodies for high levels of industrial pollutants (*e.g.,* polychlorinated biphenyl, dichlorodiphenyltrichloroethane, furan compounds, *etc.*), reflecting the impacts of urban and industrial development (CSWRCB 2012). These human induced changes have substantially degraded natural productivity, biodiversity, and ecological integrity in streams throughout the area.

The area provides a critical link in the migratory pathway between the ocean and freshwater habitat in the Central Valley for three listed salmonid ESUs/DPSs: Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. CCC steelhead occur in tributary streams around the Bay Area. CCC steelhead also utilize the bay for migration and possibly rearing.

a. San Pablo Bay Tributaries

This HUC contains all of the watersheds draining into San Pablo Bay located east of the

Golden Gate Bridge, north of the San Francisco-Oakland Bay Bridge, and west of the Carquinez Bridge. This HUC contains several small to medium-sized watersheds within portions of six counties: Marin, Sonoma, Napa, Solano, Contra Costa, and San Francisco. Agriculture has been a significant land use within the San Pablo Bay HUC; historically orchards, dairy, and grazing were the dominant agricultural activities, though more recently vineyard development has become common within the HUC. Agricultural practices have resulted in numerous small dams and water diversions that alter streamflows and water temperature conditions. Also, agricultural practices have likely altered sedimentation rates of streams. Urbanization is the dominant land use throughout this HUC and has affected habitat through flood control activities, urban runoff, and water development. The following streams are included on the 2012 Clean Water Act section 303(d) list of impaired water bodies for high levels of Diazinon, which can likely be attributed to urban runoff; Arroyo Corte Madera del Presidio, Corte Madera Creek, Coyote Creek, Napa River, Novato Creek, Petaluma River, Pinole Creek, Rodeo Creek, San Antonio Creek, San Pablo Creek, Sonoma Creek, and Wildcat Creek (CSWRCB 2012). In addition, Napa River, Petaluma River, Sonoma Creek are included on the section 303(d) list for nutrients, pathogens, and sedimentation related to agriculture, land development, and urban runoff. The lower Petaluma River has exceeded the California Toxic Rule and National Toxic Rule criteria for nickel; potential sources of nickel are municipal point source, urban runoff, and atmospheric deposition.

Presently, CCC steelhead occur in Arroyo Corte Madera del Presidio, Corte Madera Creek, Napa River, Sonoma Creek, Petaluma River, Novato Creek, and Pinole Creek. Environmental conditions in the upper portions of Arroyo Corte Madera del Presidio, Corte Madera Creek, and Pinole Creek watersheds are protected in parks or open space preserves. Recent surveys confirm steelhead presence in tributaries of San Pablo Bay (*e.g.*, Napa River and Petaluma River), but are insufficient to equivocally describe population trends or suggest a status change (Williams 2016). Coho salmon are thought to be extirpated from San Francisco Bay tributaries (NMFS 2012).

b. Suisun Bay Tributaries

This HUC includes all of the watersheds draining into Suisun Bay located east of the Carquinez Bridge and west of the confluence of the San Joaquin and Sacramento rivers. This HUC contains several small to medium-sized watersheds within Solano and Contra Costa counties. Urbanization, farming, cattle grazing, and vineyard development have all contributed to habitat degradation in streams in the northern portion of the HUC. Urbanization and industrial development have contributed to habitat degradation in the southern portion of the HUC. Laurel Creek, Ledgewood Creek, Mt. Diablo Creek, Pine Creek, and Walnut Creek are included on the 2012 Clean Water Act section 303(d) list of impaired water bodies for high levels of Diazinon attributable to urban runoff (CSWRCB 2012).

Suisun Creek, Green Valley Creek, and an unnamed tributary to Cordelia Slough currently support small populations of CCC steelhead (Spence 2016); these streams are all in Solano County. Streams flowing north from eastern Contra Costa County into south Suisun Bay are generally characterized by very dry summer conditions, and these streams do not currently support steelhead (Williams 2016).

c. San Francisco Bay Tributaries
This HUC includes all of the watersheds draining into San Francisco Bay south of the San Francisco-Oakland Bay Bridge and north of the Dumbarton Bridge. This HUC contains several small to medium-sized watersheds within Alameda and Contra Costa counties and contains the largest watershed draining into San Francisco Bay - Alameda Creek. Urbanization and industrial development are the predominant land use throughout the HUC; most watersheds within the HUC have severely degraded habitat. The following streams are included on the 2012 Clean Water Act section 303(d) list of impaired water bodies for high levels of Diazinon attributable to urban runoff: Alameda Creek, Alamitos Creek, Arroyo de la Laguna, Arroyo del Valle, Arroyo las Positas, Arroyo Mocho, Miller Creek, San Leandro Creek, San Lorenzo Creek, and San Mateo Creek (CSWRCB 2012). Islais Creek and Mission Creek in San Francisco are particularly polluted, and both are included on the 2002 Clean Water Act section 303(d) list of impaired water bodies for factors related to industrial point sources and combined sewer overflow. These streams are included on the list because of high levels of ammonia, chlordane, Chlorpyrifos, chromium, copper, dieldren, endosulfan sulfate, hydrogen sulfide, lead, mercury, mirex, PAHs, PCBs, silver, and zinc (CSWRCB 2012). Alameda Creek, Mt. Diablo Creek, San Leandro Creek, San Lorenzo Creek, and Walnut Creek historically supported steelhead, but access is currently blocked by dams, flood control facilities, or other barriers. Habitat conditions in the lower reaches of these streams are highly degraded by urbanization, but large portions of the upper watersheds located within public park land are protected from anthropogenic pollution and are generally in relatively good condition. Currently, small populations of CCC steelhead are found in Cordinices Creek, San Leandro Creek, and San Lorenzo Creek below dams. Most other drainages that historically supported steelhead presently do not (Leidy *et al.* 2005).

d. South San Francisco Bay Tributaries
This HUC includes the watersheds draining into San Francisco Bay south of the Dumbarton Bridge. This HUC contains all of the watersheds within Santa Clara County, and a few small watersheds from San Mateo and Alameda counties. Coyote Creek is the largest watershed within the HUC. Urbanization and industrial development are the predominant land uses throughout the HUC and are the primary factors affecting aquatic habitat. The following streams from this HUC are included on the 2012 Clean Water Act section 303(d) list of impaired water bodies for high levels of Diazinon attributable to urban runoff: Calabazas Creek, Coyote Creek, Guadalupe Creek, Guadalupe River, Los Gatos Creek, Matadero Creek, San Felipe Creek, San Francisquito Creek, Saratoga Creek, and Stevens Creek (CSWRCB 2012). Calero Reservoir, Guadalupe Reservoir, and Guadalupe River are included on the section 303(d) list because of elevated levels of mercury associated with historic surface mining and associated tailings, and San Francisquito Creek is included because of excess sedimentation from nonpoint sources (CSWRCB 2012). Flood control and water development have degraded habitat throughout the HUC and numerous road crossings impair fish passage. In the Guadalupe River watershed, groundwater recharge operations release water imported from the Sacramento-San Joaquin Delta into local stream channels. On Coyote Creek, gravel mining has resulted in large in-channel pools that are populated with non-native predatory bass (*Micropterus* spp.).

Reduced numbers of CCC steelhead occur in a few watersheds of this HUC: Coyote

Creek, Guadalupe River, San Francisquito Creek, and Stevens Creek. Anadromy is blocked in each watershed by water supply reservoirs; however, small populations of CCC steelhead continue to persist downstream. Built in 1890, Searsville Dam on San Francisquito Creek blocks access to a major portion of the upper watershed including a large tributary, Corte Madera Creek. Three San Francisquito Creek tributaries downstream of Searsville Dam, Los Trancos, West Union, and Bear creeks, all currently support steelhead populations. Unfortunately, no robust data sets exists within interior San Francisco Bay watersheds that would allow conclusions to be drawn regarding current population status or trends (Spence 2016).

2.3.1.3 Central Coast Area

The Central Coast Area encompasses the coastal area from San Francisco County south along the California coast to the southern extent of San Luis Obispo County. This area includes the following seven counties: San Francisco, San Mateo, Santa Cruz, Santa Clara, Monterey, San Benito, and San Luis Obispo. Metropolitan areas within the Central Coast Area include San Francisco, Pacifica, Half Moon Bay, Santa Cruz, the Monterey Peninsula, Hollister, Gilroy, Salinas, and San Luis Obispo. The Central Coast Area includes watersheds that flow into the Pacific Ocean, which support the following three ESUs/DPSs: CCC coho salmon, CCC steelhead and S-CCC steelhead, and includes their designated critical habitats.

In general, available stream flow decreases from north to south within the Central Coast Area. In addition to highly urbanized areas, portions of the Central Coast Area are experiencing low density rural residential development. The majority of the Central Coast Area is privately owned, though there are portions under public ownership including Open Space in San Mateo County, State parklands in Santa Cruz County, and Federal lands in southern Monterey County.

The Central Coast Area contains eight HUC-8s (4th field HUCs): San Francisco Coastal South, San Lorenzo-Soquel, Pajaro, Alisal-Elkhorn Sloughs, Salinas, Estrella, Carmel, and Central Coastal. Anthropogenic factors affecting listed salmonids in these HUCs include dams constructed for water storage and aquifer recharge, summer dams constructed for recreational activities, urbanization, surface water diversion and groundwater withdrawal, in-channel sediment extraction, agriculture, flood control projects, and logging. It is unknown what surface water diversions are screened. Agriculture has had the greatest impact on the Pajaro and Salinas HUCs, while logging and urbanization have had the greatest impact on the San Lorenzo-Soquel HUC.

a. San Francisco Coastal South

This HUC contains all of the coastal watersheds from the Golden Gate Strait south to approximately the San Mateo/Santa Cruz county line. The watersheds within this HUC are wholly within San Mateo County. There are seven moderate-sized watersheds within the HUC: Pilarcitos Creek, Arroyo Leon, Purisima Creek, Tunitas Creek, San Gregorio Creek, San Pedro Creek, Pescadero Creek, and Butano Creek. There is limited urban development within this HUC; agriculture (*e.g.*, brussel sprouts and cattle) is the dominant land use within all of the watersheds. There are several State Parks and Open Space areas within this HUC. Butano Creek, San Gregorio Creek, Pomponio Creek, and Pescadero Creek are included on the 2012 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012). The pollution factors for these streams are high coliform count and sedimentation/siltation. The potential sources of these pollutants are nonpoint sources.

This HUC is within the CCC coho salmon ESU and CCC steelhead DPS. Long-term data on the abundance of coho salmon in this HUC are limited. Historical records document the presence of coho salmon in Butano Creek, Pescadero Creek, and San Gregorio Creek, though coho salmon have not been found during recent stream surveys (NMFS 2001). Five or fewer juvenile coho salmon were observed in Peters Creek in 1999, but no juveniles were observed during surveys conducted in 2000 (NMFS 2001). Aside from artificial coho production supporting the Scott Creek population (and producing strays), the species appears extirpated, or nearly so, within other surrounding watersheds (Spence 2016). Steelhead are widely distributed throughout this HUC. Steelhead were once abundant in the San Gregorio Creek watershed but are believed to be at critically low levels. Pescadero Creek likely supports the most viable steelhead population in this HUC (Titus *et al.* 2002). Recent population surveys suggest a few to several hundred adult steelhead return to the largest watersheds within this HUC (San Gregorio and Pescadero) (Williams 2016).

b. San Lorenzo-Soquel

This HUC begins approximately at the San Mateo/Santa Cruz county line in the north, containing Arroyo de los Frijoles in southern San Mateo County, south to and including Valencia Creek in Santa Cruz County. The HUC extends eastward to the Santa Cruz/Santa Clara county line. There are several moderate-sized streams within this HUC, including Gazos Creek, Carbonera Creek, Waddell Creek, Laguna Creek, Bear Creek, Bean Creek, Branciforte Creek, and Soquel Creek. The San Lorenzo River is the largest river in the HUC and the largest between the two closest major river systems - the Russian River in Sonoma County to the north and the Salinas River to the south. There is a fair amount of urban development within the HUC. Several State Parks (*e.g.*, Big Basin, Henry Cowell Redwoods, The Forest of Nisene Marks) are located within this HUC. Forestry operations are conducted on private timberlands and State forest in this HUC, including Big Creek Lumber Company and the Soquel Demonstration State Forest, respectively.

Aptos Creek, Bean Creek, Bear Creek, Boulder Creek, Branciforte Creek, Carbonera Creek, East Branch Waddell Creek, Fall Creek, Kings Creek, San Lorenzo River, San Lorenzo River Lagoon, Soquel Lagoon, Valencia Creek, and Zayante Creek are included on the 2012 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012). The pollutants in these streams are varied, including, but not limited to, pathogens, nutrients, and sedimentation/siltation. The potential sources of these pollutants are also varied. Nonpoint source, urban runoff, and road construction are just a few of the potential sources.

This HUC is within the CCC coho salmon ESU, including designated critical habitat south to, and including, the San Lorenzo River and within the CCC steelhead DPS, including critical habitat south to, and including Aptos Creek. Long-term data on the abundance of coho salmon in this HUC are limited. Historical records document the presence of coho salmon in Waddell Creek, East Branch Waddell Creek, Scott Creek, Big Creek, San

Vicente Creek, San Lorenzo River, Hare Creek, Soquel Creek, and Aptos Creek. A coho salmon captive broodstock program operates on Scott Creek at Kingfisher Flat Hatchery, one of two such broodstock programs within the CCC ESU (the other is at Warm Springs Hatchery in the Russian River). Records of adult spawners and outmigrating smolts from Waddell Creek between 1932 and 1942 (Shapovalov and Taft 1954) constitute the only historical record of abundance in this HUC (NMFS 2001). The San Lorenzo River represents the southern extent of designated critical habitat for CCC coho salmon although they were historically documented at least as far south as Aptos Creek. Alteration of stream flow (due to in-channel stream flow diversions and pumping via wells for domestic use) and excessive sedimentation are two primary factors affecting CCC steelhead and CCC coho salmon critical habitat in the San Lorenzo River. Rearing juvenile coho salmon were observed in 2005 in the San Lorenzo River for the first time since 1982. Coho salmon are still found in Scott and Waddell Creeks and were rediscovered in San Vicente Creek in 2002 and observed for the first time in Laguna Creek in 2005. Steelhead are widely distributed throughout this HUC. Gazos, Waddell, and Scott Creeks are in relatively good condition, overall, for CCC steelhead.

c. Pajaro

This HUC is comprised of the Pajaro River and its tributaries and is located in portions of Santa Cruz, Santa Clara, Monterey, and San Benito counties. Moderate-sized tributaries to the Pajaro River include Corralitos Creek, Uvas Creek, Llagas Creek, Pacheco Creek, and Santa Ana Creek. The San Benito River is also a tributary to the Pajaro River. This HUC encompasses several municipalities, including the cities of Watsonville, Gilroy, Morgan Hill, and Hollister. Agriculture is the dominant land use within all of the watersheds in this HUC. Clear Creek, Corralitos Creek, Hernandez Reservoir, Llagas Creek, Tequisquita Slough, and Watsonville Slough are included on the 2012 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012). The pollutants in these streams are varied, including, but not limited to, mercury, fecal coliform, and sedimentation/siltation. The potential sources of these pollutants are also varied. Nonpoint source, resource extraction (*e.g.*, via in-channel gravel mining), and pasture grazing are just a few of the potential sources. The Pajaro River is also included on the 2012 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012). The Pajaro River contains the following pollutants: fecal coliform, nutrients, and sedimentation/siltation. Agriculture and pasture grazing are two potential sources of the pollutants.

The Pajaro HUC is within the S-CCC steelhead DPS and designated critical habitat. The distribution and abundance of steelhead within this HUC are significantly reduced. The majority of the streams where steelhead are known to be present, are located in the northwest portion of the HUC (*e.g.*, Uvas, Llagas, Corralitos, and Pachecho creeks). The mainstem Pajaro River once contained suitable spawning and rearing habitat for S-CCC steelhead, but currently functions solely as a migratory corridor because of impacts from flood control projects, agriculture, and water withdrawals for agricultural use.

The San Benito River has been adversely impacted by water withdrawals for agricultural use and in-channel sediment extraction. Steelhead have not been documented in the San Benito River since the mid-1990s, although no formal surveys have been undertaken. However, *O. mykiss* were documented in Bird Creek (San Benito River tributary) adjacent to Hollister Hills State Park in 2003. The San Benito River is also on the 2012 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012) due to fecal coliform and sedimentation/siltation. The source of fecal coliform is unknown; agriculture, resource extraction, and nonpoint source have been identified as potential sources of this pollutant.

d. Alisal-Elkhorn Sloughs
The Alisal-Elkhorn Slough HUC encompasses watersheds between the Pajaro and Salinas rivers. This HUC has little permanent flowing water. S-CCC steelhead have been observed in the headwaters of Gabilan Creek, which contains the best freshwater habitat remaining in the HUC. The HUC features mixed oak woodlands and grasslands on rolling hills overlooking tidal salt marsh. Elkhorn Slough is a principal wetland complex in central California, and is considered one of the most ecologically important estuaries in the state and is part of the National Estuarine Research Reserve System. Land use within this HUC is primarily agriculture, though there is some urban/rural development present. Habitat within the HUC has been degraded. Portions of both nominal watersheds within this HUC are included on the 2002 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012). Alisal Slough and Gabilan Creek are included for high levels of fecal coliform and nitrates attributable to agriculture, urban runoff, natural sources, nonpoint sources, and unknown sources. Elkhorn Slough has high levels of pathogens, pesticides, and sedimentation from agricultural and nonpoint sources.

e. Salinas
The Salinas HUC is the largest in the Central Coast Area and contains the largest individual watershed within the Central Coast Area, the Salinas River. This HUC lies within interior Monterey and San Luis Obispo counties, as well as a portion of San Benito County. In addition to the Salinas River, there are three other large rivers in this HUC: the Arroyo Seco River, the San Antonio River, and the Nacimiento River. There are isolated areas of urban development, including Salinas, King City, and Paso Robles. Outside of these urban developments, agriculture is the dominant land use. Portions of the Los Padres National Forest, Ventana Wilderness, Fort Hunter Liggett, and Camp Roberts Military Reservation lie within this HUC. Several water bodies, including, but not limited to, Atascadero Creek, Blanco Drain, Cholame Creek, and the Nacimiento Reservoir, are on the 2012 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012) due to a variety of pollutants from several sources. The Salinas River is also on the 2012 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012) due to fecal coliform, nutrients, pesticides, chloride, and other pollutants derived from a variety of sources, principally agriculture.

The Salinas HUC is within the S-CCC steelhead DPS. The distribution and abundance of steelhead within the HUC are greatly reduced. The Salinas River is used as a migration corridor by S-CCC steelhead. Two of the largest tributaries, the San Antonio and Nacimiento rivers, have been dammed, eliminating steelhead access to valuable spawning and rearing habitat and severely modifying stream flow. These dams, along with an additional dam on the upper mainstem, in-channel sediment extraction, channel modification and water withdrawals for agricultural use, have significantly affected the Salinas River. The Arroyo Seco River contains the best spawning and rearing habitat for S-CCC steelhead in this HUC. A number of partial passage barriers affect steelhead access to habitat.

f. Estrella
This HUC is comprised of the Estrella River and its tributaries. Streams within the HUC include Little Chalome Creek, Cholame Creek, Navajo Creek, Sixteen Spring, and San Juan Creek. Only one creek in this HUC, Cholame Creek, is listed on the 2002 Clean Water Act section 303(d) list of water quality limited segments. Cholame Creek is listed as impaired for boron and fecal coliform (CSWRCB 2012). S-CCC steelhead use of this HUC is believed to be extremely limited due to infrequent and inadequate winter flow regimes in the HUC and the mainstem Salinas River. Critical habitat of S-CCC steelhead was not designated for the Estrella River HUC. Historic occurrences of steelhead were documented by Franklin (2001), however, it is unknown if steelhead persist in this HUC.

g. Carmel
This HUC is comprised of the Carmel River and its tributaries. Moderate-sized streams within the HUC include Las Gazas Creek, Chupines Creek, and Tularcitos Creek. None of the streams within this HUC are on the 2012 Clean Water Act section 303(d) list of water quality limited segments. There is urban development within the Monterey Peninsula and limited rural residential development elsewhere. Portions of the Los Padres National Forest lie within this HUC. The Carmel River presently maintains the largest adult run of steelhead in the S-CCC DPS (Titus *et al.* 2002) and is designated critical habitat. Impacts to S-CCC steelhead include three dams on the mainstem that hinder migration, water withdrawals for domestic use, agricultural, and golf course use, and channel modifications for flood control purposes.

h. Central Coastal
This long and narrow HUC contains all of the coastal watersheds from San Jose Creek near Point Lobos State Reserve in Monterey County down to the San Luis Obispo/Monterey County border. Most of the streams in this HUC are short-run and high-gradient, draining directly to the Pacific Ocean. Moderate-sized streams within this HUC include the Little Sur River and the Big Sur River. This HUC is within the S-CCC steelhead DPS and is designated critical habitat. This Central Coastal HUC has experienced the least amount of adverse impacts within the Central Coast Area. The Little Sur River is recognized as the most productive steelhead river (per stream mile) south of San Francisco Bay at this time (Titus *et al.* 2002). The Big Sur River is in relatively good condition as well, but anadromy is limited due to natural barriers.

2.3.2 Previous Section 7 Consultations in the Action Area

The North Central Coastal California Office conducts numerous informal and formal section 7 consultations across their jurisdictional area each year. The majority of the consultations are informal consultations that did not adversely affect listed species. A low number (less than 30) of formal biological opinions are produced each year that authorize take and have terms and conditions that minimize take of listed anadromous fish. One jeopardy biological opinion in the Russian River watershed exists and the applicants are currently implementing the RPAs associated with the biological opinion.

2.3.3 Climate Change Impacts in the Action Area

Information discussed above in the species status section indicates that listed salmonids in the action area have already experienced some detrimental impacts from climate change. These detrimental impacts across the action area are likely to be minor because natural and local climate factors continue to drive most of the climatic conditions salmonids experience. These natural factors are likely less influential on salmonid abundance and distribution than anthropogenic impacts across the action area. However, in the future impacts in the action area from climate change are likely to increase as air and water temperatures warm, and precipitation rates change. Based on the likely climate change impacts, NMFS assumes that fewer areas of the watersheds in the action area will be suitable for listed salmonids by the latter half of this century, absent efforts to improve habitat conditions and increase resistance and resiliency to climate change impacts.

2.4 Effects of the Action

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

Of the proposed restoration project types, several types are expected to have only beneficial effects to listed species. Water conservation projects that occur beyond a diversion point (barrier to fish), do not interact with fish or their habitat and provide benefits by increasing instream water availability. Riparian habitat restoration actions occurring outside of the wetted channel are expected to have only beneficial effects to fish and their habitat.

Except for riparian habitat restoration and streamflow augmentation, all proposed restoration types are expected to result in adverse effects to listed species. Despite the different scope, size, intensity, and location of these proposed restoration actions, the potential adverse effects to listed salmonids all result from dewatering, fish relocation, and increased sediment into rivers and streams. Dewatering, fish relocation, and structural placement will result in direct effects to listed salmonids, where a small percentage of individuals are expected to be injured or killed. The effects from increased sediment mobilization into streams are usually indirect effects, where the effects to habitat, individuals, or both, are reasonably certain to occur and are later in time.

a. Insignificant Miniscule or Discountable Improbable Effects to Listed Species or Their Critical Habitat

   The following seven proposed project types may adversely affect listed species; however, some components of the projects also may result in effects, such as habitat disturbance from heavy equipment operation, riparian vegetation disturbance, chemical contamination, and reduced benthic macroinvertebrate production that are not likely to adversely affect listed species or their critical habitats. These effects are expected to be insignificant or discountable as explained further below.

1. Noise, Motion, and Vibration Disturbance from Heavy Equipment Operation

Noise, motion, and vibration produced by heavy equipment operation is expected at most instream restoration sites. However, the use of equipment, which will occur primarily outside the active channel, and the infrequent, short-term use of heavy equipment in the wetted channel to construct cofferdams, is expected to result in insignificant adverse negligible effects to listed fishes. Listed salmonids will be able to avoid interaction with instream machinery by temporarily relocating either upstream or downstream into suitable habitat adjacent to the worksite. In addition, the minimum distance between instream project sites and the maximum number of instream projects under the proposed Program would further reduce the potential aggregated effects of heavy equipment disturbance on listed salmonids

2. Disturbance to Riparian Vegetation

Most proposed fisheries restoration actions are expected to avoid disturbing riparian vegetation through the proposed avoidance and minimization measures. In general, the restorative nature of these projects is to improve habitat conditions for salmonids, and thus, riparian vegetation disturbance is expected to be avoided, as practicable. However, there may be limited situations where avoidance is not possible.

In the event that streamside riparian vegetation is removed, the loss of riparian vegetation is expected to be small, due to minimization measures, and limited to mostly shrubs and an occasional tree. Most riparian vegetation impacts are expected to affect typical riparian species such as willows and other shrubs, which are generally easier to reestablish since they resprout and grow quickly. In addition, the revegetation of disturbed riparian areas is expected to further minimize the loss of vegetation. Therefore, NMFS anticipates only an insignificant negligible loss of riparian habitat and function within the action area to result from the proposed restoration activities.

3. Chemical Contamination from Equipment Fluids

Equipment refueling, fluid leakage, and maintenance activities within and near the stream channel pose some risk of contamination and potential take. In addition to toxic chemicals associated with construction equipment, water that comes into contact with wet cement during construction of a restoration project can also adversely affect water quality and may harm listed salmonids. However, all fisheries restoration projects will include the measures outlined in the sections entitled, *Measures to Minimize Disturbance From Instream Construction* and *Measures to Minimize Degradation of Water Quality* within Part IX of the CDFW Manual, which address and minimize pollution risk from equipment operation. Therefore, water quality degradation from toxic chemicals associated with the habitat restoration projects is discountable improbable.

4. Reduced Benthic Macroinvertebrate Community

Benthic (*i.e*., bottom dwelling) aquatic macroinvertebrates may be temporarily lost or their abundance reduced when stream habitat is dewatered (Cushman 1985). Effects to aquatic macroinvertebrates resulting from stream flow diversions and dewatering will be temporary because instream construction activities occur only during the low flow season, and rapid recolonization (about one to two months) of disturbed areas by macroinvertebrates are expected following rewatering (Cushman 1985, Thomas 1985, Harvey 1986). In addition, the effect of macroinvertebrate loss on juvenile coho salmon, Chinook salmon, or steelhead is likely to be negligible because food from upstream sources (via drift) would be available downstream of the dewatered areas since stream flows will be maintained around the project work site. Based on the foregoing, the loss of aquatic macroinvertebrates resulting from dewatering activities is not likely to adversely affect coho salmon, Chinook salmon, or steelhead.

2.4.1 Effects to Listed Salmonids

a. Dewatering

Although all project types include the possibility of dewatering, not all individual project sites will need to be dewatered. Based on the RC's biological assessment (NOAA 2015), there were 35 projects of 71 that required dewatering during a nine year period from 2006-2015. When dewatering is necessary, only a small reach of stream at each project site will be dewatered for instream construction activities. Dewatering encompasses placing temporary barriers, such as a cofferdam, to hydrologically isolate the work area, re-routing stream flow around the dewatered area, pumping water out of the isolated work area, relocating fish from the work area (discussed separately), and restoring the project site upon project completion. The length of contiguous stream reach that will be dewatered for most projects is expected to be less than 500 feet and no greater than 1000 feet for any one project site.

Because the proposed dewatering would occur during the low flow period, the species and life stages most likely to be exposed to potential effects of dewatering are juvenile coho salmon and juvenile steelhead. Most juvenile Chinook salmon would be avoided since the timing of the instream activities occur after they have migrated to the ocean. A few juvenile Chinook salmon, especially with a stream-type life history strategy, as well as adult summer run steelhead and half-pounder steelhead, may also be exposed where these individuals are present at or near the proposed project sites, although past relocation results indicated the chances of encountering these species and life stages is very low (Flosi *et al.* 2010). Dewatering will occur during a short period (usually one to two weeks) from June 15 to October 31 and, therefore, should avoid exposure to adult salmonids.

The effects of dewatering result from the placement of the temporary barriers, the trapping of individuals in the isolated area, and the diversion of streamflow. Rearing juvenile coho salmon, steelhead, and to a much lesser extent, juvenile stream-type Chinook salmon could be killed or injured if crushed during placement of the temporary barriers, such as cofferdams, though crushing is expected to be minimal due to evasiveness of most juveniles. Stream flow diversions could harm salmonids by concentrating or stranding them in residual wetted areas (Cushman 1985) before they are relocated, or causing them to move to adjacent areas of poor habitat (Clothier 1953, Clothier 1954, Kraft 1972, Campbell and Scott 1984). Salmonids, especially juveniles since they are not as visible as adults, not caught during the relocation efforts would be killed from either construction activities or desiccation.

Changes in flow are anticipated to occur within and downstream of project sites during dewatering activities. These fluctuations in flow, outside of dewatered areas, are anticipated to be small, gradual, and short-term, which should not result in any harm to salmonids. Stream flow in the vicinity of each project site should be the same as free-flowing conditions, except during dewatering and in the dewatered reach where stream flow is bypassed. Stream flow diversion and project work area dewatering are expected to cause temporary loss, alteration, and reduction of aquatic habitat.

Dewatering may result in the temporary loss of rearing habitat for juvenile salmonids. The extent of temporary loss of juvenile rearing habitat should be minimal because habitat at the restoration sites is typically degraded and the dewatered reaches are expected to be less than 500 feet per site and no more than a total of 1000 feet per project. These sites will be restored prior to project completion, and should be enhanced by the restoration project.

Effects associated with dewatering activities will be minimized due to the multiple minimization measures that will be utilized as described in the section entitled, *Measures to Minimize Impacts to Aquatic Habitat and Species During Dewatering of Projects* within Part IX of the CDFW Manual. Juvenile coho salmon, steelhead and stream-type Chinook salmon that avoid capture in the project work area will die during dewatering activities. NMFS expects that the number of coho salmon, Chinook salmon, or steelhead that will be killed as a result of barrier placement and stranding during site dewatering activities is very low, likely less than three percent of the total number of salmonids in the project area. The low number of juveniles expected to be injured or killed as a result of dewatering is based on the low percentage of projects that require dewatering (*i.e.*, generally only up to three percent), the avoidance behavior of juveniles to disturbance, the low number of juveniles in the typically degraded habitat conditions common to proposed restoration sites, and the low numbers of juvenile salmonids expected to be present within each project site after relocation activities.

b. Fish Relocation Activities

All project sites that require dewatering will include fish relocation. Typically, designated agents capture and relocate fish (and amphibians) away from the restoration project work site to minimize adverse effects of dewatering to listed salmonids. Fish in the immediate project area will be captured by seine, dip net and/or by electrofishing, and will then be transported and released to a suitable instream location. Post monitoring of project sites may also require fish relocation if juveniles are stranded or they are in poor water quality conditions.

Juvenile coho salmon and steelhead life stages are most likely to be exposed to fish relocation during dewatering and fish relocation. Most juvenile Chinook salmon will not be exposed since the timing of instream construction occurs after they have emigrated from streams. However, a few juvenile Chinook salmon, especially those with a stream-type life history strategy, may also be exposed where these individuals are stranded within the dewatering area.

Fish relocation activities may injure or kill rearing juvenile coho salmon and steelhead because these individuals are most likely to be present in the project sites. Any fish collecting gear, whether passive or active (Hayes 1983) has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of injury and mortality attributable to fish capture varies widely depending on the method used, the ambient conditions, and the expertise and experience of the field crew. The effects of seining and dip-netting on juvenile salmonids include stress, scale loss, physical damage, suffocation, and desiccation. Electrofishing can kill juvenile salmonids, and researchers have found serious sublethal effects including spinal injuries (Reynolds 1983, Habera *et al.* 1996, Habera *et al.* 1999, Nielsen 1998, Nordwall 1999). Based on prior experience with current relocation techniques and protocols likely to be used to conduct the fish relocation, unintentional mortality of listed juvenile steelhead and salmon expected from capture and handling procedures is not likely to exceed 3 percent of the fish subjected to handling, and can be reduced to near 1 percent with increased skill and experience of the operator.

Most of the stress and death from handling result from differences in water temperature between the stream and the temporary holding containers, dissolved oxygen levels, the amount of time that fish are held out of the water, and physical injury. Handling-related stress increases rapidly if water temperature exceeds 18 °C or dissolved oxygen is below saturation. A qualified fisheries biologist will relocate fish, following both CDFW and NMFS electrofishing guidelines. Because of these measures, direct effects to, and mortality of, juvenile coho salmon and steelhead during capture will be greatly minimized.

Although sites selected for relocating fish will likely have similar water temperature as the capture site and should have ample habitat, in some instances relocated fish may endure short-term stress from crowding at the relocation sites. Relocated fish may also have to compete with other salmonids, which can increase competition for available resources such as food and habitat. Some of the fish at the relocation sites may choose not to remain in these areas and may move either upstream or downstream to areas that have more habitat and lower fish densities. As each fish moves, competition remains either localized to a small area or quickly diminishes as fish disperse.

Fish relocation activities are expected to minimize individual project impacts to juvenile coho salmon and steelhead by removing them from restoration project sites where they would have experienced high rates of injury and mortality. Fish relocation activities are anticipated to only affect a small number of rearing juvenile coho salmon and/or steelhead within a small stream reach at and near the restoration project site and relocation release site(s). Rearing juvenile coho salmon and/or steelhead present in the immediate project work area will be subject to disturbance, capture, relocation, and related short-term effects. Most of the take associated with fish relocation is anticipated to be non-lethal, however, a very low number of rearing juvenile (mostly young of the year) coho salmon and/or steelhead captured may become injured or die. In addition, the number of fish affected by increased competition is not expected to be significant at most fish relocation sites, based upon the suspected low number of relocated fish inhabiting the small project areas. Also, most juvenile Chinook salmon are expected to migrate to estuarine or the ocean environment by June 15th of each year, but in some cases small numbers of juvenile Chinook salmon are expected to be encountered during fish relocation. Similar affects from electrofishing or seining during fish relocation are expected for Chinook salmon as for coho salmon and steelhead juveniles.

Effects associated with fish relocation activities will be significantly minimized due to the multiple minimization measures that will be utilized, as described in the section entitled, *Measures to Minimize Injury and Mortality of Fish and Amphibian Species During Dewatering* within Part IX of the CDFW Manual. NMFS expects that fish relocation activities associated with implementation of individual restoration projects will not significantly reduce the number of returning listed salmonid adults. Fish relocation activities will occur during the summer low-flow period after emigrating smolts have left the restoration project sites and before adult fish travel upstream. Therefore, the majority of listed salmonids that will be captured during relocation activities will be young of the year coho and juvenile steelhead of various ages. Although most mortalities of coho salmon and/or steelhead during fish relocation activities will occur almost exclusively at the young of the year stage, there is a potential of unintentional mortality of a one- or two-year old fish.

NMFS is able to estimate the maximum number of federally listed salmonids expected to be captured, injured, and killed each year from relocation activities using electrofishing and seining from past project information. From 2006-2015, thirty-five fish relocation projects relocated 4,770 juvenile salmonids with 91 mortalities which resulted in a mortality of 1.9 percent. Approximately the same numbers of projects are expected to occur on an annual basis which is 4 to 5 projects requiring dewatering and/or relocation. Given past numbers of salmonids captured over nine years of similar activities, we expect that approximately 500 to 600 juveniles to be relocated each year. This average number of expected individual fish captured can be much higher when high numbers of young of the year salmonids are present. Typically this occurs with steelhead that spawn late in the spring and young of the year fry are abundant and have not yet found suitable habitat or experienced natural mortality associated with density dependent habitat factors. For example, one past project relocated over 1700 juvenile steelhead at one restoration site. In this case the number of mortalities was under the expected 3 percent, but totaled 45 young of the year steelhead. It is possible to have one or two of these types of dewatering projects per DPS, or ESU each year (J. Pecharich, personal communication 2016). For CCC coho salmon and CC Chinook we do not expect large numbers of young of the year since spawning occurs in the previous fall, and most Chinook migrate out during the spring. CCC coho numbers are low across much of their range, and we expect fewer coho than steelhead will need to be relocated.

The maximum number of individual juvenile steelhead in each DPS expected to be injured or killed is based on the maximum number of juveniles relocated and a 3 percent mortality rate which results in 120 fish each year. This assumes two projects in a DPS that has large numbers of young of the year steelhead (2000 per project) and a 3 percent mortality rate. As described above, a relatively low mortality rate is expected due to the proposed measures for fish capture and relocation outline above in the project description. For salmon ESUs much lower numbers of juvenile fish are expected to injured or killed during each construction season. From 2006 to 2015 very few juvenile salmon were captured during dewatering and relocation activities and only one juvenile Chinook salmon mortality was observed. Given that restoration actions across ESUs are likely to increase numbers of salmon we expect that an increase in salmon will be captured. Based on past relocation information, we estimate that as many as 300 juvenile CCC coho salmon could be captured in each year, and 100 Chinook salmon given their respective life histories and the variability in flow and habitat conditions across each ESU. Therefore, with an expected 3 percent mortality associated with these activities results in the potential loss of 9 juvenile coho, and 3 juvenile Chinook salmon annually. In general the measures ensure that fish capture and relocation will occur during the appropriate habitat conditions, by qualified individuals numbers of mortalities are expected to be much lower than maximum numbers that could occur given conditions and population variability across DPSs and ESUs.

c. Increased Mobilization of Sediment within the Stream Channel

The proposed restoration project types involve various degrees of earth disturbance. Inherent with earth disturbance is the potential to increase background suspended sediment loads for a short period during and following project completion.

All project types involving ground disturbance in or adjacent to streams are expected to increase turbidity and suspended sediment levels within the project work site and downstream areas. Therefore, instream habitat improvement, instream barrier modification for fish passage improvement, stream bank stabilization, fish passage improvements at stream crossings, small dam removal[7], creation of off channel/side channel habitat, and upslope watershed restoration may result in increased mobilization of sediment into streams.

In general, sediment-related effects are expected during the summer construction season (June 15 to November 1), as well as during peak-flow winter storm events when remaining loose sediment is mobilized. During summer construction, the species and life stages most likely to be exposed to potential effects of increased sediment mobilization are juvenile coho salmon and juvenile steelhead. As loose sediment is mobilized by higher winter flows, adult Chinook salmon, coho salmon, and steelhead may also be exposed to increased turbidity. Removal of small dams and road crossing projects will have potential for releasing sediment due to sediment volume typically stored behind these structures. However, minimization measures, such as removing excess sediment stored upstream of the dam will limit the amount of sediment released to downstream reaches. The increased mobilization of sediment is not likely to degrade spawning gravel because project related sediment mobilization would be minimal due to the use of sideboards and minimization measures. These include the size of the dam allowed in this program (25 feet or less), engineering and biological review, only one project allowed per HUC 12 each year and removal of sediment if required. Based on past projects implemented through this program, the NOAA RC staff report that relatively small amount of sediment is expected from these projects and affect only a short distance downstream, and should be easily

[7] Because of the sideboards and engineering requirements described in the proposed action, small dam removal is expected to have similar sediment mobilization effects as culvert replacement or removal.

displaced by either higher fall/winter flows or redd building (J. Pecharich, personal communication 2015). In the winter, the high flows will carry excess fine sediment downstream to point bars and areas with slower water velocities. Because redds are built where water velocities are higher, the minimally increased sediment mobilization is not expected reach levels that will smother existing redds. Therefore, salmonid eggs and alevin are not expected to be exposed to the negligible increase in fine sediment on redds. Since most restoration activities will focus on improving areas of poor instream habitat, NMFS expects low numbers of fish inhabiting individual project areas (NOAA RC 2015b) during these periods of increased sediment input, and thus directly affected by construction activities, to be relatively small.

Restoration activities may cause temporary increases in turbidity and deposition of excess sediment may alter channel dynamics and stability (Habersack and Nachtnebel 1995, Hilderbrand *et al.* 1997, Powell 1997, Hilderbrand *et al.* 1998). Erosion and runoff during precipitation and snowmelt will increase the supply of sediment to streams. Heavy equipment operation in upland and riparian areas increases soil compaction, which can increase runoff during precipitation. High runoff can then, in turn, increase the frequency and duration of high stream flows in construction areas. Higher stream flows increase stream energy that can scour stream bottoms and transport greater sediment loads farther downstream than would otherwise occur.

Sediment may affect fish by a variety of mechanisms. High concentrations of suspended sediment can disrupt normal feeding behavior (Berg and Northcote 1985), reduce growth rates (Crouse *et al.* 1981), and increase plasma cortisol levels (Servizi and Martens 1992). Increased sediment deposition can fill pools and reduce the amount of cover available to fish, decreasing the survival of juveniles (Alexander and Hansen 1986) and holding habitat for adults. Excessive fine sediment can interfere with development and emergence of salmonids (Chapman 1988). Upland erosion and sediment delivery can increase substrate embeddedness. These factors make it harder for fish to excavate redds, and decreases redd aeration (Cederholm *et al.* 1997). High levels of fine sediment in streambeds can also reduce the abundance of food for juvenile salmonids (Cordone and Kelly 1961, Bjornn *et al.* 1977).

Short-term increases in turbidity are anticipated to occur during dewatering activities and/or during any instream construction activities. Research with salmonids has shown that high turbidity concentrations can: reduce feeding efficiency, decrease food availability, reduce dissolved oxygen in the water column, result in reduced respiratory functions, reduce tolerance to diseases, and can also cause fish mortality (Berg and Northcote 1985, Gregory and Northcote 1993, Velagic 1995, Waters 1995). Mortality of very young coho salmon and steelhead fry can result from increased turbidity (Sigler *et al.* 1984). Even small pulses of turbid water will cause salmonids to disperse from established territories (Waters 1995), which can displace fish into less suitable habitat and/or increase competition and predation, decreasing chances of survival. Nevertheless, much of the research mentioned above focused on turbidity levels significantly higher than those likely to result from the proposed restoration activities, especially with implementation of the proposed avoidance and minimization measures.

In contrast, the lower concentrations of sediment and turbidity expected from the proposed restoration activities are unlikely to be severe enough to cause injury or death of listed juvenile coho salmon and/or steelhead. Instead, the anticipated low levels of turbidity and suspended sediment resulting from instream restoration projects will likely result in only temporary behavioral effects. Monitoring of replaced culverts[8] within the action area detailed a range in turbidity changes downstream of newly replaced culverts following winter storm events (Humboldt County 2002, 2003 and 2004). During the first winter following construction, turbidity rates (NTU) downstream of newly replaced culverts increased an average of 19 percent when compared to measurements directly above the culvert. However, the range of increases within the 11 monitored culverts was large (n=11; range 123% to 21%). Monitoring results from one- and two-year-old culverts were much less variable (n=11; range: 12% to 9%), with an average increase in downstream turbidity of one percent. Although the culvert monitoring results show decreasing sediment effects as projects age from year one to year three, a more important consideration is that most measurements fell within levels that were likely to only cause slight behavioral changes [*e.g.*, increased gill flaring (Berg and Northcote 1985), elevated cough frequency (Servizi and Marten 1992), and avoidance behavior (Sigler *et al.* 1984)]. Turbidity levels necessary to impair feeding are likely in the 100 to 150 NTU range (Harvey 1986). Only one of the Humboldt County measurements exceeded 100 NTU (NF Anker Creek, year one), whereas the majority (81 percent) of downstream readings were less than 20 NTU. Importantly, proposed minimization measures, some of which were not included in the culvert work analyzed described above will likely ensure that future sediment effects from fish passage projects will be less than those discussed above. Therefore, the small pulses of moderately turbid water expected from the proposed instream restoration projects will likely cause only minor physiological and behavioral effects, such as dispersing salmonids from established territories, potentially increasing interspecific and intraspecific competition, as well as predation risk for the small number of affected fish.

Upslope watershed restoration activities, such as road decommissioning and upgrading, are expected to mobilize sediment through ripping and re-contouring. However, these activities are generally higher up in the watersheds where the adjacent streams are typically first or second order, and are typically not fish bearing. Sediment mobilization will be minimized through road outsloping, reseeding and mulching disturbed areas, and other erosion control measures. These erosion control measures should prevent a majority of the sediment from reaching fish bearing streams. In addition, road assessments which are required prior to funding implementation projects which have been funded by the RC indicate that the subject roads pose significant sediment problems for salmonids, and are in need of upgrading, repair, or decommissioning. Therefore, upslope road work (*e.g.,* road decommissioning), when implemented with the proposed preventative erosion control measures, will reduce overall yield to streams over the short and long term.

Upslope restoration activities, in the long term, should result in reduced sediment volume than unimproved roads. Road upgrading and decommissioning activities have been documented to reduce road-related erosion and landslide risk (Madej 2001, McCaffery *et al.* 2007). Road decommissioning studies in the Redwood Creek watershed, Humboldt

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[8] When compared to other instream restoration projects (*e.g.*, bank stabilization, instream structure placement), culvert replacement/upgrade projects typically entail a higher degree of instream construction and excavation, and by extension greater sediment effects. Thus, we have chosen to focus on culvert projects as a "worst case" scenario when analyzing potential sediment effects from instream projects.

County, have found that treated roads, on average, contributed only 25% of the sediment volume produced from untreated roads (Madej 2001). Vegetation, in particular, when reestablished on decommissioned roads, leads to reduced fine sediment in adjacent streams (McCaffery *et al.* 2007). The amount of fine sediment mobilized from highly revegetated decommissioned roads can be at levels that existed prior to the road construction (McCaffery *et al.* 2007).

Road restoration projects may entail culvert replacement or removal, the resulting sediment effect is expected to be significantly smaller when compared to a typical fish passage improvement project. Road restoration projects typically deal with upslope road networks located high within the watershed drainage network. As a result, typical road crossings in these upslope areas largely occur in higher gradient, first or second order stream channels and feature small (*e.g.,* less than 4-foot diameter) culverts. In contrast, fish passage projects funded through the Program typically focus limited restoration funding on high-priority fish passage issues located on third or fourth order stream networks that, when completed, will re-establish fish access to large expanses of upstream habitat. In effect, both the size and gradient of upslope channels and culverts largely limit downstream sediment impacts during road projects. Small, high gradient stream channels typically transport sediment downstream more efficiently (and therefore store less upstream of the culvert) than lower gradient, higher order stream reaches where flow and channel morphology favor sediment deposition. Furthermore, the comparative size of these upslope road culverts (16-48 inch diameter) likely limit the volume of any sediment wedge that can develop upstream of the structure. Because of these unique characteristics common to culverts typically found on upslope roads, NMFS anticipates individual culvert projects that are part of a larger road project will not approach an effect level similar to larger fish passage projects, and thus are consider as part of the road project when computing maximum project density per HUC 12 watershed (as detailed in the section titled "Number and Location of Anticipated Projects" within the Proposed Action).

NMFS does not expect sediment effects to accumulate at downstream restoration sites within a given watershed. Sediment effects generated by each individual project will likely impact only the immediate footprint of the project site and up to approximately 500 to 1500 meters of channel downstream of the site. Studies of sediment effects from culvert construction determined that the level of sediment accumulation within the streambed returned to control levels between 358 to 1,442 meters downstream of the culvert (LaChance *et al.* 2008). Because of the multiple measures to minimize sediment mobilization, described in the CDFW Manual under *Measures to Minimize Degradation of Water Quality,* on pages IX-50 and IX-51, downstream sediment effects from the proposed restoration projects are expected to extend downstream for a distance consistent with the range presented by LaChance *et al.* (2008). The proposed limitation of three projects (only one road and one dam project) per HUC 12 each year will ensure that sediment disturbance across a watershed is minimized sufficiently to avoid sediment effects from accumulating in downstream stream reaches. Furthermore, the temporal and spatial scale at which project activities are expected to occur will also likely preclude significant additive sediment related effects. Assuming projects will continue to be funded and implemented similar to the past several years, NMFS expects that individual restoration projects sites will occur over a broad spatial scale each year. In other words, restoration projects occurring in close proximity to other projects during a given restoration season is unlikely, thus diminishing the chance that project effects would combine. Finally, effects to instream habitat and fish are expected to be short-term, since most project-related sediment will likely mobilize during the initial high-flow event the following winter season. Subsequent sediment mobilization may occur following the next two winter seasons, but generally should subside to baseline conditions by the third year as found in other studies, such as Klein *et al.* (2006), and suggested by the Humboldt County data (Humboldt County 2004).

2.4.2 Effects to Critical Habitat

<u>2.4.2.1 Adverse Effects to PBFs</u>

The critical habitat designation for salmonid species includes several PBFs which will be affected under the proposed action. These PBFs include spawning, rearing, and migration habitats.

Juvenile rearing sites require cover and cool water temperatures during the summer low flow period. Over-wintering juvenile salmonids require refugia to escape high flows in the winter. Adverse effects to rearing habitat will primarily occur as a result of dewatering the channel and increasing sediment input during instream restoration activities. Loss or reduction in quality of rearing sites can occur through dewatering habitat and the filling of pools with sediment. However, these adverse effects are expected to occur during one construction period during the summer and wetted habitat will be typically be restored within in one to two weeks. Post project sediment impacts to stream reaches are expected to be minor due to sediment reduction BMPs implemented at projects that create ground disturbance. The activities described in the proposed action will increase quality of rearing habitat over the long term. Rearing habitat will be improved by adding complexity that will increase pool formation, cover structures, and velocity refugia.

As explained above, spawning habitat is not likely to be adversely affected by the temporary increase in fine sediment resulting from proposed activities. Spawning habitat is located where water velocities are higher, where mobilized fine sediment is less likely to settle. Where limited settling does occur in spawning habitat, the minor increased sediment is not expected to degrade spawning habitat due to the small amounts and short term nature of the effects. Minor amounts of sediment transported by the first winter rains are expected to be redeposited to low velocity areas (sand bars which are not spawning areas) by high flow events throughout the winter period. Activities described in the proposed action will improve the quality of spawning habitat over the long term. Spawning habitat will be improved by reducing the amount of fine sediment that enters the stream in the long term through various types of erosion control. Additionally, specific gravel augmentation projects, described in the proposed action will increase the amount of spawning habitat available.

Migratory habitat is essential for juvenile salmonids outmigrating to the ocean as well as adults returning to their natal spawning grounds. Juvenile migratory habitat may be affected during the temporary re-routing of the channel during project implementation, however a migratory corridor will be maintained at all times. The proposed action will have long term beneficial effects to migratory habitat. Activities adding complexity to habitat will increase the number of pools, providing resting areas for adults, and the removal of barriers will increase access to habitat.

Misguided restoration efforts often fail to produce the intended benefits and can even result in further habitat degradation. Improperly constructed projects can cause greater adverse effects than the pre-existing condition. The CDFW Manual provides design guidance and construction techniques that facilitate proper design and construction of restoration projects. Properly constructed stream restoration projects will increase available habitat, habitat complexity, stabilize channels and streambanks, increase spawning gravels, decrease sedimentation, and increase shade and cover for salmonids. Since 2004, the percentage of fisheries restoration projects implemented under CDFG's FRGP rated as either good or excellent ranged between 71 to 96 percent, with an average of 87 percent (Collins 2005, CDFG 2006, 2007, 2008, 2009, 2010). NMFS assumes similar success rates will result from the proposed Program due to the similarity between this proposed Program and the FRGP program. Therefore, most of the proposed restoration actions should continue to be effectively implemented, and thus enhance existing habitat conditions at the project sites.

In addition to instream restoration projects, barrier modification for fish passage improvement and small dam removal activities may cause delivery of fine and course sediments to salmonid habitat. These activities generally utilize heavy equipment (*e.g.*, self-propelled logging yarders, mechanical excavators, backhoes, *etc.*) to conduct in-channel work and regrade the channel post barrier removal. The RC and Corps have recognized the higher level of sediment disturbance by these project types require additional review by the RC and NMFS staff. Because of this, the proposed action specifies that eligible dam removal projects must (1) be approved by CDFW and/or NMFS fish passage engineers (2) have a relatively small volume of sediment available for release (relevant to the size of the watershed), that when released by storm flows, will have minimal effects on downstream habitat, or (3) be designed to remove sediment trapped by the dam down to the elevation of the target thalweg including design channel and floodplain dimensions. As a result of these proposed conditions and others included in the project description, NMFS believes that these measures are sufficient to minimize impacts associated with increased mobilization of fine sediment in action area creeks because the instream sediment source will either be minimal in quantity, removed in its entirety, or of a quality that will enhance sediment starved reaches downstream.

In summary, the Program activities described in the *Proposed Action* are restoration projects that are intended to restore natural watershed functions that have been disrupted by anthropogenic activities. Inherent within these Program activities is the potential that certain activities (*e.g.*, culvert replacement, small dam removal, and bank restoration) will increase background suspended sediment loads. With regard to fine sediments, minor releases into flowing water during dewatering activities are expected, then additional minor amounts are not expected until the first fall rains occur. The sideboards proposed not only limit the duration of effects, also limit the magnitude of the effects. Sediment effects are expected to remain minimal and not accumulate by implementing sideboards that limit the number of, and distance between sediment producing activities. Because of the proposed protection measures, it is anticipated that the expected increase in background sediment levels resulting from restoration activities will only cause some short term adverse effects to steelhead or salmon critical habitat.

2.4.2.2 Beneficial Effects to PBFs

Habitat restoration projects that are funded by the RC and authorized by the Corps will be designed and implemented consistent with the techniques and minimization measures presented in the CDFW Manual to maximize the benefits of each project while minimizing effects to salmonids. Most restoration projects are for the purpose of restoring degraded salmonid habitat and are intended to improve instream cover, pool habitat, spawning gravels, and flow levels; remove barriers to fish passage; and reduce or eliminate erosion and sedimentation sources. Although some habitat restoration projects may cause small losses to the juvenile life history stage of listed salmonids in the project areas during construction, all of these projects are anticipated to improve salmonid habitat and salmonid survival over the long-term.

a. Instream Habitat Improvements

Instream habitat structures and improvement projects will provide escape from predators and resting cover, increase spawning habitat, improve upstream and downstream migration corridors, improve pool to riffle ratios, and add habitat complexity and diversity. Some structures will be designed to reduce sedimentation, protect unstable banks, stabilize existing slides, provide shade, and create scour pools.

Placement of LWD into streams can result in the creation of pools that influence the distribution and abundance of juvenile salmonids (Spalding *et al.* 1995, Beechie and Sibley 1997). LWD influences the channel form, retention of organic matter and biological community composition. In small (<10 m bankfull width) and intermediate (10 to 20 m bankfull width) streams, LWD contributes channel stabilization, energy dissipation and sediment storage (Cederholm *et al.* 1997). Presence and abundance of LWD is correlated with growth, abundance and survival of juvenile salmonids (Fausch and Northcote 1992, Spalding *et al.* 1995). The size of LWD is important for habitat creation (Fausch and Northcote 1992).

For placement of root wads, digger logs, upsurge weirs, boulder weirs, vortex boulder weirs, boulder clusters, beaver dam analogues and boulder wing-deflectors (single and opposing), long-term beneficial effects are expected to result from the creation of pools that will provide rearing habitat for juvenile coho salmon and steelhead. Improper use of weir and wing-deflector structures can cause accelerated erosion on the opposing bank, however, this can be avoided with proper design and implementation. Proper placement of single and opposing log wing-deflectors and divide logs, will provide long-term beneficial effects from the creation or enhancement of pools for summer rearing habitat and cover for adult salmonids during spawning. Proper placement of digger logs will likely create scour pools that will provide complex rearing habitat, with overhead cover, for juvenile salmonids and low velocity resting areas for migrating adult salmonids. Spawning gravel augmentation will provide long-term beneficial effects by increasing spawning gravel availability while reducing inter-gravel fine sediment concentrations.

Also, for projects where stream bank erosion is a concern, the various weir structures and wing-deflector structures likely to be authorized under the proposed program direct flow away from unstable banks and provide armor (a hard point) to protect the toe of the slope from further erosion. Successfully reducing streambank erosion will offset the increased sediment mobilization into streams from other restoration actions authorized under the proposed program. Boulder faces in the deflector structures have the added benefit of providing invertebrate habitat, and space between boulders provides juvenile salmonid escape cover.

The various weir structures can also be used to replace the need to annually build gravel push up dams. Once these weir structures are installed and working properly, construction equipment entering and modify the channel would no longer be needed prior to the irrigation season. The benefits of reducing or eliminating equipment operation during the early spring reduces the possibility of crushing salmon and steelhead redds and young salmonids.

b. Stream Bank and Riparian Habitat Restoration

Stream bank and riparian habitat restoration projects will reduce sedimentation from bank erosion, decrease turbidity levels, and improve water quality for salmonids over the long-term. Reducing sediment delivery to the stream environment will improve fish habitat and fish survival by increasing fish embryo and alevin survival in spawning gravels, reducing injury to juvenile salmonids from high concentrations of suspended sediment, and minimizing the loss of quality and quantity of pools from excessive sediment deposition. Successful implementation of stream bank and riparian habitat restoration projects will offset the increased sediment delivery into streams from other restoration actions authorized under the proposed Program. In addition, the various proposed streambank and riparian habitat restoration activities are likely to enhance native riparian forests or communities, provide increased cover (large wood, boulders, and vegetation structures) and a long-term source of all sizes of instream wood.

c. Fish Passage Improvement at Stream Crossings and small dams

Thousands of old or poorly designed stream crossings exist on roadways throughout the coastal drainages of northern and central California, many preventing listed salmonids from accessing vast expanses of historic spawning and rearing habitat located upstream of the structure. In recent years, much attention has been focused on analyzing fish passage at stream crossings through understanding the relationship between culvert hydraulics and fish behavior (Six Rivers National Forest Watershed Interaction Team 1999).

Reestablishing the linkages between mainstem migratory habitat and headwater spawning/rearing habitat will help to facilitate the recovery of salmonids throughout the action area. Reestablishing passage for listed salmonids into previously unavailable upstream habitat will also likely increase reproductive success and ultimately fish population size in watersheds where the amount of quality freshwater habitat is a limiting factor.

d. Upslope Watershed Restoration

Upslope watershed restoration projects will stabilize potential upslope sediment sources, which will reduce excessive delivery of sediment to anadromous salmonid streams. Some of these projects will reduce the potential for catastrophic erosion and delivery of large amounts of sediment to stream channels. Road improvement projects will reduce sediment delivery to streams in the long-term. Road decommissioning projects should be even more beneficial than road improvement projects in that all or nearly all of the hydrologic and sediment regime effects of the roads would be removed. Long-term beneficial effects resulting from these activities include restored hydrologic function including transport of sediment and LWD, reduced risk of washouts and landslides, and reduced sediment delivery to streams. In the long-term, these projects will tend to rehabilitate substrate habitat by reducing the risk of sediment delivery to streams and restore fish passage by correcting fish barriers caused by roads. Road decommissioning projects will also tend to rehabilitate impaired watershed hydrology by reducing increases in peak flows caused by roads and reducing increases in the drainage network caused by roads.

2.5 Cumulative Effects

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

Non-Federal activities that are reasonably certain to occur within the action area include agricultural practices, water withdrawals/diversions, mining, state or privately sponsored habitat restoration activities on non-Federal lands, road work, timber harvest, and residential growth.

A search of upcoming timber harvest plans on the CalFire website confirms that timber harvesting is expected to continue in the next five years (http://www.fire.ca.gov/ResourceManagement/THPStatusUpload/THPStatusTable.html). NMFS assumes these activities, and similar resultant effects (as described in the *Status of the Species* and *Environmental Baseline* sections), on listed salmonids species will continue on an annual basis over time.

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.

2.6 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 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5), 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) reduce the value of designated or proposed critical habitat for the conservation of the species.

The CCC coho salmon ESU has not shown improvement since its original listing in 1996 as threatened (61FR56138), and then as endangered in 2012 (77FR19523). The best available updated information on the biological status of this ESU and the threats facing this ESU indicate that it continues to be in danger of extinction (Williams 2016).

The 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; residential and commercial development; and severe weather. The impacts of these major threats are described in the effects to critical habitat section.

Steelhead populations throughout northern and central California have also shown a decrease in abundance, but are still widely distributed throughout most of the DPS. Although NC, CCC, and SCCC steelhead have experienced significant declines in abundance, and long-term population trends suggest a negative growth rate, they have maintained a better distribution overall when compared to the CCC coho salmon ESU. This suggests that, while there are significant threats to the population, they possess a resilience (based in part, on a more flexible life history) that likely slows their decline. However, the poor condition of their habitat in many areas and the compromised genetic integrity of some stocks pose a risk to the survival and recovery of these steelhead DPSs. Based on the above information, recent status reviews and available information indicate NC, CCC, and SCCC steelhead are likely to become endangered in the foreseeable future.

The most recent CC Chinook salmon status review found continued evidence of low population sizes relative to historical abundance. Although mixed abundance trends within some larger watersheds in the north may suggest some populations are persisting, the low abundance, low productivity, and potential extirpations of populations in the southern part of the CC Chinook salmon ESU are of concern. The reduced abundance contributes significantly to long-term risk of extinction, and is likely to contribute to short-term risk of extinction in the foreseeable future. Thus, NMFS concludes the CC Chinook salmon ESU falls far short of historic population numbers and distribution, and is therefore not viable in regards to the population size VSP parameter. The ESU's geographic distribution has been moderately reduced, but especially for southern populations in general, and spring-run Chinook populations in particular. Based on the above information, recent status reviews and available information indicate CC Chinook are likely to become endangered in the foreseeable future.

Currently accessible salmonid habitat throughout the action area has been severely degraded, and the condition of designated critical habitats, specifically their ability to provide for long-term salmonid conservation, has also been degraded from conditions known to support viable salmonid populations. Intensive land and stream manipulation during the past century (*e.g.*, logging, agricultural/livestock development, mining, urbanization, and river dams/diversion) has modified and eliminated much of the historic salmonid habitat in central and northern California. Impacts of concern include alteration of stream bank and channel morphology, alteration of water temperatures, loss of spawning and rearing habitat, fragmentation of habitat, loss of downstream recruitment of spawning gravels and LWD, degradation of water quality, removal of riparian vegetation resulting in increased stream bank erosion, increases in erosion entry to streams from upland areas, loss of shade (higher water temperatures), and loss of nutrient inputs (61 FR 56138).

Projects authorized under the Program are for the purpose of restoring anadromous salmonid habitat, take will likely result from fish relocation activities and the temporary effects of sediment mobilization, modified hydrology, and other minor effects. NMFS anticipates only small numbers of juvenile salmon and/or steelhead may be adversely affected at each individual restoration project work site. Adverse effects to listed salmonids at these sites are primarily expected to be in the form of short-term behavioral effects with minimal mortality. Salmonids present during project construction may be disturbed, displaced, injured or killed by project activities, and salmonids present in the project work area will be subject to capture, relocation, and related stresses. Most unintentional mortalities of salmon and/or steelhead during fish relocation activities and dewatering will occur exclusively at the juvenile stage. Short-term impacts to salmonid habitat from restoration activities will be minimal and localized at each project site. The duration and magnitude of direct effects to listed salmonids and to designated critical habitat associated with implementation of individual restoration projects will be significantly minimized due to the multiple minimization measures that will be utilized during implementation. The temporal and spatial limits (*i.e.*, sideboards) included in the proposed action will minimize significant additive effects. NMFS anticipates the effects of individual restoration projects will not reduce the number of returning listed salmonid adults. Even though salmonid numbers are dramatically reduced from historical abundance in the affected ESU and DPSs, juvenile losses are very small compared to the total number of juveniles that continue to rear in each watershed in the action area each year, and these small losses, by their small size alone, are unlikely to affect adult returns in a watershed or ESU/DPS. In addition, the low numbers of juvenile fish to be captured, injured or killed will be spread over a large geographical area and therefore reduce the effect to abundance and distribution by not concentrating all effects on any one population.

NMFS has determined these effects are not likely to appreciably reduce the numbers, distribution or reproduction of salmon and/or steelhead within each watershed where restoration projects occur. This is based on the Program's numeric limit on projects each year (maximum of 40), projects are spaced across a large geographic area, and that projects have required minimization and avoidance measures that result in short-term effects from restoration project construction. All of the restoration projects are intended to restore degraded salmonid habitat and improve instream cover, pool habitat, and spawning gravel; remove barriers to fish passage; and reduce or eliminate erosion and sedimentation impacts. These restoration projects are selected based the priorities set forth in current recovery plans and in close coordination with CDFW and NMFS staff biologists working in watershed recovery areas. Projects are generally prioritized based on the population structure with priority given to independent populations that are a priority for achieving viability across ESUs and DPSs.

Although there will be short-term impacts to salmonid habitat associated with some of the projects implemented each year, NMFS anticipates nearly all projects implemented will provide long-term improvements to salmonid habitat. NMFS also anticipates that the additive beneficial effects to instream salmonid habitat conditions for multiple life stages of salmonids and should improve survival of local populations of salmonids into the future. High threats to salmonid recovery, such as poorly designed roads, and passage migration barriers will be reduced as a result of implementing the proposed action. In addition, restored habitat resulting from restoration projects should improve adult spawning success, juvenile survival, and smolt outmigration, which will in turn lead to improved abundance, productivity, spatial structure, and diversity within the watershed population. As individual population viability improves, the viability of the ESU's and DPS are expected to improve as well. The likely improvements in population viability will help these populations become more resistant and resilient to climate change impacts which are likely to increase in the action area and across the ESUs and DPSs as the Program continues forward into the future.

2.7 Conclusion

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

2.8 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.

The measures described below are nondiscretionary, and must be undertaken by RC and the Corps so that they become binding conditions of any grant or permit issued for the exemption in section 7(o)(2) to apply. The RC and Corps have a continuing duty to regulate the activity covered by this incidental take statement. If the RC or Corps (1) fails to assume and implement the terms and conditions or (2) fails to require an applicant to the Program to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the RC or the Corps must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

2.8.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take would occur as follows:

NMFS expects the proposed project will result in incidental take of listed CCC coho salmon, CC Chinook salmon, NC steelhead, CCC steelhead and SCCC steelhead on an annual basis. Juvenile coho salmon, steelhead and to a lesser extent stream-type juvenile Chinook salmon will be harmed, injured, or killed from the dewatering and fish relocating activities at the project sites. Specifically, incidental take is expected to be in the form of capture during dewatering and fish relocation activities. NMFS expects no more than 3 percent of the juvenile salmon and steelhead captured will be injured or killed each year. For each of the steelhead DPSs which can have large numbers of young of the year fish present during dewatering and relocation activities we expect up to 4000 juvenile steelhead to be captured and relocated and up to 120 juveniles (most will be young of the year) injured or killed during each year of the program. Much lower numbers of juvenile CCC coho salmon and CC Chinook salmon are expected at restoration sites and based on past dewatering and relocation information we expect 300 CCC coho salmon to be captured and relocated and the loss of 9 CCC coho salmon and the capture and relocation of 100 CC Chinook salmon juveniles, and 3 to be injured or killed during each year of the Program.

2.8.2 Effect of the Take

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

2.8.3 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).

a. Measures shall be taken to minimize the amount or extent of incidental take of listed salmonids resulting from fish relocation, dewatering, or instream construction activities.

b. Measures shall be taken to ensure that individual restoration projects authorized annually through the Program will minimize take of listed salmonids, monitor and report take of listed salmonids, and to obtain specific project information to better assess the effects and benefits of salmonid restoration projects authorized through the Program.

c. Measures shall be taken to handle or dispose of any individual CCC coho salmon, CC Chinook salmon, NC steelhead, CCC steelhead, or SCCC steelhead actually killed.

2.8.4 Terms and Conditions

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

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

   Measures shall be taken to minimize the amount or extent of incidental take of listed salmonids resulting from fish relocation, dewatering, or instream construction activities:

   1. Fish relocation data must be provided annually as described in Term and Condition 2b (below). Any injuries or mortality from a fish relocation site that exceeds three percent[9] of a listed species shall be reported to the nearest NMFS office within 48 hours and relocation activities shall cease until a RC biologist is on site to supervise the remainder of relocation activities.

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

   Measures shall be taken to ensure that individual restoration projects authorized annually through the Program will minimize take of listed salmonids, monitor and report take of listed salmonids, and to obtain specific project information to better account for the effects and benefits of salmonid restoration projects authorized through the Program.

   1. In order to monitor the impact and to track incidental take of listed salmonids, the RC and/or the Corps must annually submit to NMFS a report of the previous year's restoration activities. The annual report shall include a summary of the specific type and location of each project, stratified by individual project, watershed, affected species and ESU/DPS. The report shall include the following project-specific summaries:

      - Summary detailing fish relocation activities, including the number and species of fish relocated and the number and species injured or killed. Any capture, injury, or mortality of adult salmonids will be noted in the monitoring data and report. Any injuries or mortality from a fish relocation site that exceeds three percent of the affected listed species shall have an explanation describing why.

      - The number and type of instream structures implemented within the stream channel.

[9] Only when injury or mortality exceeds 10 individuals of the affected species, to minimize the need to report when only a small number of listed species are injured or killed from a small total capture size.

- The length of streambank (feet) restored or planted with riparian species.

- The number of culverts replaced or repaired, including the number of miles of restored access to unoccupied salmonid habitat.

- The distance (miles) of road decommissioned.

- The distance (feet) of aquatic habitat disturbed at each project site.

This report shall be submitted annually by March 1 to the North-Central Coast NMFS office:

National Marine Fisheries Service
North-Central Coast Office
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404

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

Measures shall be taken to handle or dispose of any individual CCC coho salmon, CC Chinook salmon, NC, CCC, or SCCC steelhead actually taken (mortality).

1. All steelhead, Chinook salmon, and coho salmon mortalities must be retained, placed in an appropriately sized whirl-pak or zip-lock bag, labeled with the date and time of collection, fork length, location of capture, and frozen as soon as possible. Frozen samples must be retained until specific instructions are provided by NMFS.

2.9 Conservation Recommendations

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

NMFS has no conservation recommendation for this proposed action.

2.10 Reinitiation of Consultation

This concludes formal consultation for the Program to fund, and/or permit restoration projects within the NMFS Santa Rosa Office jurisdictional area in California.

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

2.11 "Not Likely to Adversely Affect" Determinations

NMFS does not anticipate the proposed action will adversely affect Southern Green Sturgeon DPS (*Acipenser medirostris*). The Southern DPS of North American green sturgeon spawn in the upper reaches of the Sacramento River. Adult green sturgeon exhibit an extensive marine existence, traveling as far north along the Pacific west coast as Alaska. These fish return from the ocean every few years in the late winter to spawn, and generally show fidelity to their upper Sacramento River spawning sites. Therefore, individuals from Southern DPS of Green Sturgeon are not expected to be present in the action area (freshwater streams and estuaries located in Figure 1 above[10]) during the implementation of habitat restoration projects , and restoration projects affects will be discountable or insignificant due to implementation of project design and minimization measures. NMFS concurs with the RCs determination that the proposed action is not likely to adversely affect Green Sturgeon or its critical habitat because its effects are expected to be insignificant.

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

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

This analysis is based, in part, on the EFH assessment provided by the NOAA Restoration Center and the Corps of Engineers and descriptions of EFH for Coastal pelagic species (PFMC 2011), Pacific coast salmon (PFMC 2014), Pacific coast groundfish (PFMC 2016) contained in the fishery management plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

Pacific coast salmon, Pacific groundfish, and Coastal pelagic EFH may be adversely affected

[10] Action area in Figure 1 does not include the San Francisco Bay.

by the proposed action. EFH areas for these species are shown in Figure 2 below. Specific habitats identified in PFMC (2014) for Pacific coast salmon include Habitat areas of Particular Concern (HAPCs), identified as: 1) complex channels and floodplain habitats; 2) thermal refugia; and 3) spawning habitat. HACPs for salmon also include all waters and substrates and associated biological communities falling within the habitat areas defined above. Essentially, all coho and Chinook habitat located within the proposed action are considered HACP as defined in PFMC (2014). These HAPC EFH areas include current and historical distribution of salmon in California obtained from Calfish (2012) and NMFS (2005a; 2005b)(as cited in PFMC 2014).

Estuaries in the action area that may be adversely affected for pacific groundfish (PFMC 2016), and coastal pelagic species (PFMC 2011) are those existing within the area shaded in Figure 2 (excluding the San Francisco Bay). Many of these estuaries contain eelgrass (*Zostera marina*), which is also designated as EFH-HAPCs for groundfish. EFH for coastal pelagic species includes estuaries and ocean waters outward to the limit of the U.S. exclusive economic zone.

Restoration activities typically occur in watersheds and estuaries subjected to significant levels of logging, road building, urbanization, mining, grazing, and other activities that have reduced the quality and quantity of instream habitat available for native anadromous salmonids. Types of permitted projects include: instream habitat improvement, fish passage improvement (including construction of new fish ladders/fishways and maintenance of existing ladders), bank restoration, riparian restoration, upslope restoration, and stream or estuary restoration. The majority of the actions considered in the accompanying biological opinion (BO) follow those described in: (1) California Department of Fish and Game's (CDFG) *California Salmonid Stream Habitat Restoration Manual, Third Edition, Volume II* with three new chapters *(Part IX: Fish Passage Evaluation at Stream Crossings, Part X: Upslope Assessment and Restoration Practices, and Part XI: Riparian Habitat Restoration*) added in 2003 and 2004 (Flosi *et al.* 2010), (2) NMFS' *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2000), and (3) NMFS' *Fish Screening Criteria for Anadromous Salmonids* (NMFS 2011).

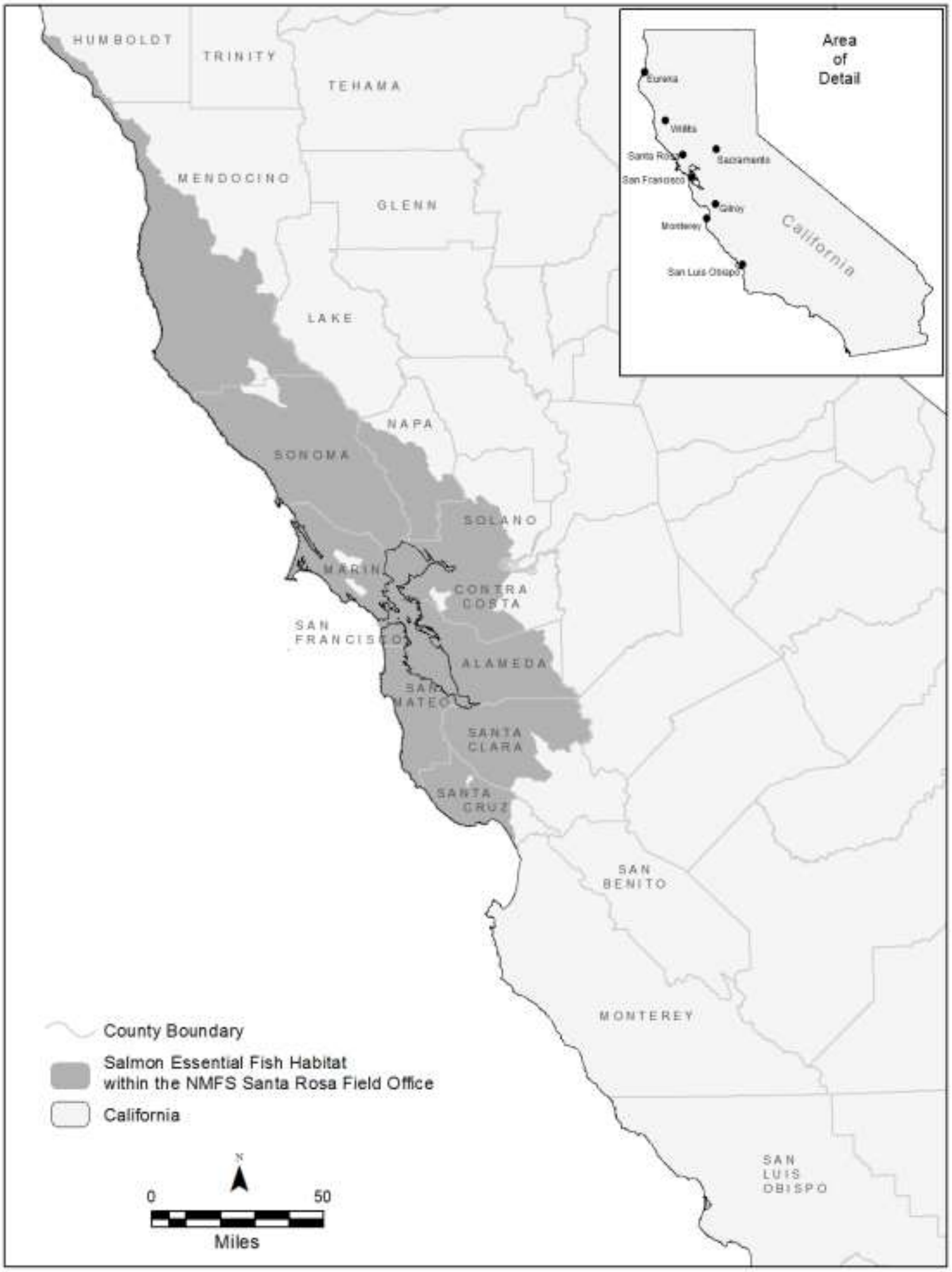

Figure 2. EFH area included in the RC and Corps restoration program for CC Chinook and CCC coho salmon as indicated by shaded regions. Estuaries occurring along the shaded area are included for Pacific groundfish and coastal pelagic species. Action area does not include the San Francisco Bay.

3.2 Adverse Effects on Essential Fish Habitat

NMFS has evaluated the proposed project for potential adverse effects to EFH pursuant to Section 305(b)(2) of the MSFCMA. As described and analyzed in the accompanying BO, NMFS anticipates some short-term sediment impacts will occur downstream of the project locations and outward from banks of estuarine areas. Increased fine sediment could further degrade already degraded habitat conditions in many of the proposed project locations. Flowing water may be temporarily diverted around some projects (salmon EFH only), resulting in short-term loss of habitat space and short-term reductions in macroinvertebrates (food for EFH species).

The duration and magnitude of direct effects to EFH associated with implementation of individual conservation projects will be significantly minimized due to the multiple minimization measures utilized during project execution. Short-term adverse effects that occur will be offset by long-term beneficial effects to the function and value of EFH.

3.3 Essential Fish Habitat Conservation Recommendations

Section 305(b)(4)(A) of the MSFCMA authorizes NMFS to provide EFH Conservation Recommendations that will minimize adverse effects of an activity on EFH. Although short-term potential adverse effects anticipated as a result of project activities, the proposed minimization and avoidance measures in the Enclosure 1 are sufficient to avoid, minimize and/or mitigate for the anticipated affects. Therefore, no EFH additional Conservation Recommendations are necessary at this time to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH.

3.4 Supplemental Consultation

The NOAA Restoration Center and the Corps of Engineers 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 NOAA Restoration Center and the Corps of Engineers. Other interested users could include permit or license applicants, restoration grand recipients, citizens of affected areas, others interested in the conservation of the affected ESUs/DPS. Individual copies of this opinion were provided to the NOAA Restoration Center and the Corps of Engineers. This opinion will be posted on the Public Consultation Tracking System web site (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). The format and naming adheres to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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

Refer to NMFS No: WCR-2017-8532

August 31, 2018

Jennifer Steger
Pacific Region Supervisor
NOAA Restoration Center
777 Sonoma Avenue, Room 219-A
Santa Rosa, California 95404

Nancy A. Haley
Chief, California North Branch
Regulatory Division
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814

Donald Ratcliff
Central Valley Supervisor,
Fish and Aquatic Conservation
Pacific Southwest Region
U.S. Fish and Wildlife Service
2800 Cottage Way
Sacramento, California 95825

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response and Fish and Wildlife Coordination Act Recommendations for the NOAA Restoration Center's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California

Dear Ms. Steger, Ms. Haley, and Mr. Ratcliff:

Thank you for your letter of November 7, 2017, and subsequent information received on April 20, 2018, where you requested 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 NOAA Restoration Center's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California. Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1855(b)) for this action.

With this letter, we provide to you NMFS's biological opinion (opinion) and EFH consultation based on our review of the NOAA Restoration Center's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California. The opinion analyzes the effects of the proposed action on endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), threatened California Central Valley steelhead (*O. mykiss*), threatened Southern Distinct Population Segment (sDPS) of North American green sturgeon (*Acipenser medirostris*), and their designated critical habitats per section 7 of the ESA. From our analysis NMFS concludes that the proposed action is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, threatened California Central Valley steelhead, threatened sDPS green sturgeon, or adversely modify or destroy designated critical habitats for listed fish. Additionally, NMFS has included an incidental take statement with reasonable and prudent measures (RPM) and non-discretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of these listed species.

NMFS also concludes that the proposed action will have minimal adverse effects to Pacific salmon, and Pacific groundfish EFH. Section 305(b)(2) of the MSA authorizes NMFS to provide EFH conservation recommendations to minimize adverse effects of an activity on EFH. Because any adverse effects to EFH will be minimal and multiple benefits to these habitats are expected, EFH conservation recommendations are not offered beyond what's been considered in the terms and conditions of the RPM. However, if the proposed action is modified in a manner that may adversely affect EFH, the NOAA Restoration Center, U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service will need to reinitiate EFH consultation with NMFS.

Please contact Evan Sawyer (evan.sawyer@noaa.gov) at the NMFS California Central Valley Office, (916) 930-3656, if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

for Maria Rea

Barry A. Thom
Regional Administrator

Enclosure

cc: To the File 51422-WCR2017-SA00386

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

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

NOAA Restoration Center's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California

NMFS Consultation Number: WCR-2017-8532

Action Agencies: NOAA Restoration Center, the U.S. Army Corps of Engineers, and the United States Fish and Wildlife Service

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?
Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*)	Endangered	Yes	No	Yes	No
Central Valley spring-run Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
California Central Valley steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Southern Distinct Population Segment (sDPS) of North American green sturgeon (*Acipenser medirostris*)	Threatened	Yes	No		

Affected 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 Ground Fish	Yes	No

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

Issued By: Maria Rea

for Barry A. Thom
Regional Administrator

Date: August 31, 2018

TABLE OF CONTENTS

1. INTRODUCTION

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

1.1 Background

This consultation concerns the effects of the proposed Program to Facilitate Implementation of Restoration Projects in the Central Valley of California (Program) and associated restoration activities on endangered Sacramento River (SR) winter-run Chinook salmon (*Oncorhynchus tshawytscha*), and threatened Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha)*, California Central Valley (CCV) steelhead Distinct Population Segment (DPS) (*O. mykiss*), southern DPS (sDPS) of North American green sturgeon (*Acipenser medirostris*), and their respective designated critical habitats.

Although many new and existing funding sources for restoration in the Central Valley possess a clear federal nexus, they tend to lack an efficient regulatory review process with the National Marine Fisheries Service (NMFS). Currently, each project must undergo Endangered Species Act (ESA) section 7 consultation, which can be time consuming and increase the costs of regulatory compliance. In a 2015 survey, Sustainable Conservation queried close to 20 restoration proponents throughout the Central Valley about the types and sizes of projects to be implemented as well as the future demand for permitting over the next decade (NMFS 2017). Restoration proponents showed unanimous support for a programmatic approach to permitting for restoration in the Central Valley, finding that the project-by-project ESA section 7 review slowed project implementation and increased agency staff workload and costs. Responding to the perceived need, the NOAA Restoration Center (RC), U.S. Army Corps of Engineers (Corps), and U.S. Fish and Wildlife Service (USFWS), with help from Sustainable Conservation, have developed a Program to facilitate the implementation of restoration projects in the Central Valley such that the potential adverse impacts from covered projects are minimized to the greatest extent practicable. The Program has been designed with the intent to avoid the majority of impacts to listed anadromous species and their habitats in the Central Valley and builds on similar programmatic consultations between NMFS, the NOAA RC and the Corps for restoration activities in the North, Central and Southern California coastal regions since 2006. With this Program and through this programmatic consultation with the NOAA RC, USFWS and the Corps, an accelerated review and implementation of fisheries habitat restoration activities for listed Central Valley anadromous species is expected.

NMFS prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with Section 7(b) of the ESA of 1973 (16 USC 1531 et seq.) and implementing regulations at 50 CFR 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600. Because the proposed action would modify a stream or other body of water, NMFS also provides recommendations and comments for the purpose of conserving fish and wildlife resources, and enabling the Federal agency to give equal consideration with other project purposes, as required under the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.).

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available through NMFS' Public Consultation Tracking System https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts. A complete record of this consultation is on file at the NMFS California Central Valley Office (CCVO).

1.2 Consultation History

The following list of meetings, correspondence and conversations catalogs the significant work that went into the development of the Program and this consultation.

- March 17, 2016, a phone conference was held between NMFS (Charlotte Ambrose) and Sustainable Conservation (a non-profit organization which provides technical assistance to the NOAA Restoration Center (RC) and NMFS to benefit restoration activities in California) to develop a strategy for a programmatic ESA section 7 consultation for restoration in the Central Valley, similar to previous consultations for restoration in the coastal areas of California, and to determine the appropriate staff from NOAA RC and NMFS who would attend subsequent coordination meetings.

- May 4, 2016, an initial meeting was held at the NMFS California Central Valley Office. Staff from NMFS, NOAA RC and Sustainable Conservation discussed the development of a programmatic consultation for restoration projects in the Central Valley, including the need for the Program due to increased restoration project funding from California Proposition 1 funding and other sources. A follow-up meeting with the Sacramento and San Joaquin Branch Chiefs of NMFS was planned to get further support for the proposal.

- June 8, 2016, a follow-up meeting with NMFS staff and Branch Chiefs, NOAA RC and Sustainable Conservation occurred at the NMFS office in Sacramento to further refine an outline (including project types) and timeline for the programmatic consultation. Sustainable Conservation agreed to conduct a Request for Proposals (RFP) process to hire a consulting firm to help with preparation of the Biological Assessment (BA).

- July 27, 2016, Maria Rea, Assistant Regional Administrator, submitted a letter to Sustainable Conservation to confirm NMFS' commitment to the programmatic consultation process for Central Valley restoration projects.

- August 11, 2016, a conference call with NMFS, NOAA RC and Sustainable Conservation was held to determine the lead staff from NMFS for the consultation process and the level of coordination between the NOAA RC, Sustainable Conservation and NMFS needed during the development of the BA. Discussed timing and process for engaging Corps as a co-lead federal agency.

- October 18, 2016, a Draft BA outline, list of project types for inclusion in the BA, and action area map was sent to NMFS via email for review and comment, prior to drafting the BA.

- November 9, 2016, a Draft General Conservation Measures Technical Memorandum was sent on behalf of NOAA RC and the Corps via email to NMFS staff for review and comment, prior to incorporating these measures into the Administrative Draft of the BA.

- May 26, 2017, Administrative Draft No. 1 of the BA was sent on behalf of NOAA RC via email to the Corps and NMFS staff for review and comment.

- July 18, 2017, a workshop was held at NOAA's offices in Sacramento with NOAA RC and NMFS to discuss NMFS' staff comments on Administrative Draft No. 1 of the BA.

- August 28, 2017, Administrative Draft No. 2 of the BA was sent on behalf of NOAA RC and the Corps via email to NMFS staff for review and comment.

- September 13, 2017, NMFS staff provided comments to NOAA RC and the Corps on Administrative Draft No.2.

- November 7, 2017, on behalf of NOAA RC and the Corps, Sustainable Conservation submitted to NMFS the *FINAL Biological Assessment and Essential Fish Habitat Assessment for a Program to Facilitate Implementation of Restoration Projects in the Central Valley of California*, and requested initiation of ESA consultation.

- December 7, 2017, Sustainable Conservation provided supplemental information to assist with the development of an ITS.

- December 22, 2017, NMFS sent a letter confirming an initial initiation date of November 8, 2017, for the consultation with the NOAA RC and the Corps on the NOAA RC's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California.

- March 13, 2018, Sustainable Conservation, NOAA RC and the U.S. Fish and Wildlife Service (USFWS) discussed the inclusion of USFWS as a co-lead federal action agency to the Program.

- April 20, 2018, on behalf of NOAA RC, the Corps and USFWS, Sustainable Conservation submitted to NMFS a revised BA, which also included USFWS as a co-lead federal action agency, which restarted initiation of consultation.

- May 1, 2018, USFWS confirmed that they have requested to be added to the BA as a co-lead federal action agency.

1.3 Proposed Federal Action

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

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

For the action described in this opinion, the NOAA RC, in coordination with the Corps (permitting) and USFWS (funding and technical assistance), proposes to fund, permit, or provide technical assistance for restoration projects within the California Central Valley so as to facilitate their implementation. General categories of restoration project types within the Program include: instream habitat improvements; barrier modification for fish passage improvement; bioengineering and riparian habitat restoration; upslope watershed restoration; removal of small dams (permanent, flashboard and other seasonal-type); fish screen installation, operation and maintenance; creation of off-channel/side-channel habitat; invasive plant removal and revegetation to improve fish and wildlife habitat; wetland and tidal marsh restoration and enhancement; piling and other instream structure removal to benefit water quality and habitat; and water conservation and streamflow augmentation projects to improve in-stream flow conditions for fish. The geographic extent of the NOAA RC's Program is described in Section 1.3.1, *Program Geographic Extent*, with the administration processes of the Program, including reporting requirements, described in Section 1.3.3, *Program Administration*. Limits to the scope of the Program are provided in Section 1.3.4, *Programmatic Sideboards and Other Program Requirements*. The majority of habitat restoration projects authorized by the Program will be designed and implemented following the techniques and minimization measures presented in agency manuals and technical guidance documents:

- CDFW Salmonid Stream Habitat Restoration Manual (Flosi et al. 2010),
- NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001, hereafter referred to as NMFS' Crossing Guidelines), and
- NMFS Fish Screening Criteria for Anadromous Salmonids (NMFS 1997, hereafter referred to as NMFS' Screening Guidelines).

For the purposes of the Program, a "restoration project" is defined as one that will result in a net increase in aquatic or riparian resource functions and services. Although a project covered by the Program may include multiple benefits, such as flood management, groundwater recharge, recreation, or climate change adaptation, all covered projects must meet the criteria of a restoration project defined by the Program and must remain consistent (i.e., address a threat to recovery, help meet a recovery goal or objective, or is determined by NMFS to be beneficial to species) with NMFS' Recovery Plan for the Evolutionarily Significant Units of Sacramento

River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead (NMFS Central Valley Salmon and Steelhead Recovery Plan) (NMFS 2014). The *Number of Anticipated Projects* is described in Section 1.3.2, with project types described in greater detail in Section 1.3.5, *Covered Project Types and Prohibited Activities.* Avoidance and minimization measures necessary for all projects are described in Section 1.3.6, *Protection Measures.*

1.3.1 Program Geographic Extent

The NOAA RC and USFWS propose to fund or provide technical assistance on restoration projects, encompassing 19,872 square miles within portions of the following counties of the NOAA RC's Sacramento Field Office Region: Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Madera, Mariposa, Merced, Nevada, Placer, Sacramento, San Benito, San Joaquin, Shasta, Solano, Stanislaus, Sutter, Tehama, Tuolumne, Yolo, and Yuba (Figure 1). Further, the Corps proposes to issue permits for the proposed projects under Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the Federal Water Pollution Control Act, as amended (Clean Water Act (CWA)), and Section 14 of the Rivers and Harbors Act of 1899 as codified in 33 United States Code (U.S.C.) 408 (e.g., Section 408), as necessary. The restoration projects will be within the NMFS's CCVO jurisdictional area and include projects permitted from 2018 into the future.

1.3.2 Number of Anticipated Projects

The number of restoration projects implemented on a yearly basis will be influenced by the available funding, interest from and capacity of restoration proponents to submit qualified project applications, project permitting and construction scheduling, and other factors. Potential funding sources for projects that adhere to the proposed Program are numerous, and include NOAA RC, USFWS, the California Department of Fish and Wildlife (CDFW), the Delta Conservancy, state and federal water contractors, U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS), U.S. Forest Service (USFS), National Parks Service (NPS), U.S. Bureau of Reclamation (BOR), U.S. Bureau of Land Management (BLM), California Wildlife Conservation Board (WCB), California Department of Water Resources (DWR), National Fish and Wildlife Foundation (NFWF), and others. Based on the expected funding and demand from restoration proponents throughout the Program geographic extent (Figure 1), the proposed action will include up to 60 active projects per year implemented under the Program. This means that at any given time during the life of the Program that only 60 concurrent projects will be covered.

The proposed action can be used to authorize activities by those who agree to carry out their projects in conformance with the standards specified in the sections below, including *Programmatic Sideboards and Other Program Requirements*, which includes management unit specific in-water work windows (Section 1.3.4), project-specific minimization measures (Section 1.3.5), general *Protection Measures* (Section 1.3.6), and *Monitoring and Reporting Requirements* (Section 1.3.7). Modified measures may be proposed by NOAA RC as appropriate, with the agreement of NMFS, based upon site-specific conditions or technological constraints or advances.

1.3.3 Program Administration

NOAA RC staff in Sacramento, California, will administer and oversee the Program to facilitate implementation of the restoration projects occurring in the jurisdiction of the CCVO of NMFS. This opinion analyzes the Program requirements, set forth by the NOAA RC, that will limit any adverse effects of individual projects as well as the cumulative adverse effects of multiple projects. These Program requirements are enacted and affected through the administration of the Program, such that all restoration projects included in the Program and analyzed by this opinion will be subject to the administration process, assessment and review described in this section.

Project Consideration

Project applications will come through the NOAA RC or USFWS for funding and/or technical assistance, or through the Corps at the time of application for a Clean Water Act Section 404 permit, a Rivers and Harbors Act Section 10 permit, and/or a Section 408 permit as codified in U.S.C. Section 408. Applications for proposed projects will be submitted by the project applicant for consideration in the Program. In addition, although a project may include multiple benefits, such as flood management, groundwater recharge or recreation, all projects in the Program must result in a net increase in aquatic or riparian resource functions and services and must be consistent with NMFS Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014) such that covered projects address an identified threat to recovery, help meet a recovery goal or objective, or is determined by NMFS to be beneficial to species.

The NOAA RC website will include contact information that enables project proponents to submit applications directly to NOAA RC staff. The NOAA RC website will also include a link to the Corps-Sacramento District Regulatory Division's website which provides instructions for the Corps' Section 404 application requirements. The NOAA RC will coordinate closely with the Corps to ensure that it has received the project application for the appropriate type of Section 404 permit.

Timeline

Project applications will be accepted throughout the year by the Corps, USFWS and/or NOAA RC and distributed to the Program's other cooperating agencies (Corps, NOAA RC, USFWS and NMFS) for review. As described below, Corps and USFWS staff may request assistance from NOAA RC for input on whether projects are consistent with the Program. As available, staff from the Corps, USFWS, NOAA RC, and NMFS will then bundle appropriate projects for review and processing approximately twice a year, in the early winter (December/January) and spring (March/April).

Submittal Requirements

The NOAA RC will take the lead for the Program and participate in the screening of individual projects under consideration for inclusion in the Program and will track implementation of individual projects. Project applicants seeking ESA coverage under the Program must submit sufficient information (described below) about their project to allow the NOAA RC, USFWS and the Corps to determine whether or not the project qualifies for coverage, regardless of whether the project applicants submit the information to the Corps (as part of their application for a Corps permit) or the NOAA RC or USFWS (for NOAA RC or USFWS-funded projects).

Applicants will be responsible for obtaining any other permits or authorizations from appropriate agencies before the start of project. Specifically, for those projects that may result in incidental take of the state-listed winter-run Chinook salmon or spring-run Chinook salmon (i.e., that will require dewatering and fish relocation activities in a stream historically known to support these two ESUs of Chinook salmon), the applicant will also need project approval from CDFW.

Applicants will provide the following information as part of a standard application:

a. Pre-project photo monitoring data (per CDFW photo-monitoring guidelines, and as described in Woodward and Hollar (2011));

b. Project description:

    i. Project problem statement;

    ii. Project goals and objectives;

    iii. Watershed context;

    iv. Description of the type of project and restoration techniques utilized (culvert replacement, instream habitat improvements, etc.);

    v. Project dimensions;

    vi. Description of construction activities anticipated (types of equipment, timing, staging areas or access roads required);

    vii. If dewatering of the work site will be necessary, description of temporary dewatering methods including qualified individual who will be onsite to capture and transport protect listed fish;

    viii. Construction start and end dates, including specific dates of in-water work and the application of work windows (described in Section 1.3.4 of this opinion);

    ix. Estimated number of creek crossings and type of vehicle;

    x. Materials to be used;

    xi. When vegetation will be affected as a result of the project (including removal and replacement), provide a visual assessment of dominant native shrubs and trees, approximate species diversity, and approximate acreage;

    xii. Description of existing site conditions and explanation of how proposed activities improve or maintain these conditions for listed species within expected natural variability;

xiii. Description of key habitat elements (i.e., temperature; type: pool, riffle, flatwater; estimate of instream shelter and shelter components; water depth; dominant substrate type, etc.) for listed species in project vicinity.

xiv. Description of applicable protection measures incorporated into the project.

xv. A proposed monitoring plan for the project describing how the applicant will ensure compliance with the applicable monitoring requirements described in the opinion (photo monitoring, revegetation, etc.), including the source of funding for implementation of the monitoring plan. Include adaptive management techniques or strategies that are informed by monitoring results.

xvi. A checklist for consistency the applicant must sign, verifying that the applicant agrees to adhere to all project conditions and protection measures during project design and implementation.

Proposed projects that deviate from the "covered" activities described in *Covered Project Types and Prohibited Activities* (Section 1.3.5) will require individual consultation. Modified protection measures (below) may be proposed by NOAA RC as appropriate, with the agreement of NMFS, based upon site-specific conditions or technological constraints or advances.

Initial Project Screening

The NOAA RC will be the first level of review in screening potential NOAA RC-funded projects, or projects requesting NOAA RC technical assistance, for authorization under the Program, including screening for more complex projects that might require additional oversight and engineering review by NMFS. The NOAA RC will determine whether a proposed project comports to the criteria of the Program. The Corps will be the first level of review in screening potential projects where the applicant applies for a Corps permit for authorization under the Program. The Corps will determine whether the proposed project comports to the criteria of the Program.

The Corps and USFWS will pre-screen projects where the applicant applied for a Corps permit for authorization under the Program or the USFWS provided funding or technical assistance. The Corps or USFWS will then turn the application over to the NOAA RC, which will use a pre-established checklist in the standard application form called the "Application for Inclusion in the NOAA RC Sacramento Office Programmatic Approach" to help determine if a proposed project fits within the parameters of the Program. Once projects have passed through the initial project screening, the NOAA RC will compile a report (project summary sheet/table) for the bundled projects to determine overall program consistency. Any projects that lack sufficient information to determine their appropriateness for inclusion in the Program are either further clarified or further developed by the project proponent and resubmitted.

Field visits by NOAA RC Staff and in some cases NMFS engineers may be necessary before projects are authorized for inclusion under the Program. Contact will typically be by email and will include the information submitted and the response of NMFS engineers. If the project is a stream crossing, dam removal, off-channel habitat feature, or any other fish passage project needing engineering review, NOAA RC will not move forward with the project until NMFS has finished engineering review or indicated via email that additional review is not needed. For other project types, those not requiring a NMFS engineering review, NOAA RC will assume a project qualifies for inclusion if it has not heard from NMFS staff within 2 weeks. The transmittal and response emails will be maintained in each project file by NOAA RC.

Authorization

With the RC's approval (and all other necessary approvals and permits obtained), authorized projects are then implemented by the applicants, incorporating all guidelines, protection measures, and additional required conditions (described in Section 1.3.6, *Protection Measures)*.

Post-Construction Implementation Monitoring

Qualifying applicants are required to conduct post-construction implementation monitoring and associated reporting requirements for their projects authorized under the Program. Monitoring and reporting will include photo-documentation consistent with the pre-construction monitoring requirements; post-construction plans on engineered projects (i.e., "as-built plans"); evidence of implementation of required protection measures; and information about the number (by species) of fish relocated and any fish mortality that resulted from the project. The applicant(s) will submit this information to the NOAA RC within 6 months of completion of construction for data assembly as described below. Applicants will be required to use the NOAA RC *Sacramento Office Programmatic Approach Post-Project Monitoring Form*, which will be given to applicants with approval of the project.

Project Tracking and Reporting

The NOAA RC, acting as lead agency, will provide tracking and oversight of all projects that are implemented under this Program. Specifically, the NOAA RC will annually prepare and submit to the NMFS California Central Valley Office a report of the previous year's restoration activities. The annual report will contain information about projects implemented during the previous construction season as well as projects implemented in prior years under the Program. This reporting will help ensure that the limits outlined by the Program, including the general minimization measures outlined in Section 1.3.6 *Protection Measures,* are adhered to, and that databases for tracking projects and any incidental take of listed species that occurs during implementation of projects authorized under the Program are accurate and available to all cooperating agencies.

The annual report will also include a summary of the specific type and location of each project, stratified by individual project and ESU and/or DPS. The report will include the following project-specific information:

- a summary detailing fish relocation activities, including the number and species of fish relocated and the number and species injured or killed;
- a map indicating the location of each project;

- the number and type of instream structures implemented within the stream channel;
- the size (acres, length, and depth) of off channel habitat features enhanced or created;
- the length of streambank (feet) stabilized or planted with riparian species;
- the number of culverts replaced or repaired, including the number of miles of restored access to unoccupied salmonid habitat;
- the size on number of dams removed, including the number of miles of restored access to unoccupied salmonid habitat;
- the distance (feet) of aquatic habitat disturbed at each project site; and
- the methods, results and discussion of effectiveness monitoring, as appropriate.

1.3.4 Programmatic Sideboards and Other Program Requirements

It is expected that projects covered under the Program will provide for habitat improvements that in turn will benefit listed species. As noted in Section 1.3.2, *Number of Anticipated Projects,* the Program will include no more than 60 concurrent projects in a year, as confirmed during the initial project screening and annual reporting. With the intent of the Program being to facilitate the implementation of restoration projects in the California Central Valley, the Program has been designed to minimize the potential for negative impacts to the greatest extent practicable. The primary way in which the Program minimizes the potential for short-term adverse impacts of individual projects, is with the use of sideboards that establish specific, measureable project criteria. Modified measures may be proposed by NOAA RC as appropriate, with the agreement of NMFS, based upon site-specific conditions or technological constraints or advances. Additionally, the NOAA RC, USFWS and the Corps have established Program limitations and requirements that must be implemented for any project to be included in the Program. The following sideboards, and other requirements proposed by the NOAA RC, USFWS and the Corps are necessary for projects to be included in the Program.

Limits to Location and Timing of Projects

In-water Work Windows

An important component of the Program, are the region specific proposed in-water work windows. The general construction season for upslope areas will be from June 1 to October 31 (outside of primary precipitation season) so as to avoid and/or minimize erosion potential. Because of the overlap in species and life-stage, it is not possible for a single in-water work window to avoid all life stages of each ESU and DPS throughout the entirety of the action area (see status of each species within the action area in Section 2.4, *Environmental Baseline*). Instead, the timing of the proposed in-water work windows for restoration projects included in the Program have been designed to avoid the most vulnerable of life stages for anadromous species, which is typically spawning and incubation due to the immobility and vulnerability of those life-stages (see Table 1-1 below). Many previous programs and agencies have taken an approach that limits in-water work windows to avoid the spawning and incubation life stages of salmonids, including the Upper Sacramento River Habitat Restoration biological opinion (NMFS 2015c), the Small Erosion Repair Program in the Sacramento River Basin (CDWR 2010), and the Oregon Department of Fish and Wildlife (2008). Using this approach as a guide, and with assistance from CDFW and NMFS CCVO staff, the proposed in-water work windows for this Program have been developed to avoid the "non-migratory" life stages of adult holding, spawning, and egg incubation while limiting exposure to less-vulnerable, "migratory" life stages of juvenile rearing and migration, and adult migration.

While the timing of non-migratory life stages between ESUs and DPSs have great overlap across the entire Central Valley, the spatial distributions for each ESU/DPS vary. Thus, the creation of spatially explicit in-water work windows at certain RKM points along a waterbody, provides the greatest flexibility in timing of construction activities. In order to achieve this, published observations of the downstream end of the spawning grounds for each ESU/DPS in the Sacramento and San Joaquin rivers and their tributaries are applied to inform the boundaries between different spatially explicit management units (MU). Finally, the life stage timing and spatial distributions of all the ESUs/DPSs were overlaid to determine work windows for four different management units across the Central Valley (see Table 1-1). A description of each management unit and corresponding work window is described and included in Table 1-1 with the locations of each management unit depicted in Figure 1-1. Any Program covered restoration, construction, fish relocation, and dewatering activities within any wetted or flowing stream channel will occur within these periods.

Extended or alternative work windows may be considered on an individual project basis if approval is applied for in advance and the applicant can demonstrate that measures implemented to avoid or minimize exposure would do so at a level commensurate with the standard in-water work windows. For example, in MU 2, instream work in these streams could start sooner than July 15 if NMFS determines that adult and juvenile CV spring-run Chinook salmon are no longer present based on environmental conditions and real time passage data, and instream work could be extended past October 31 if environmental conditions which would preclude juvenile CCV steelhead and CV spring-run Chinook salmon emigration or adult CCV steelhead immigration are expected to persist.

TABLE 1-1
IN-WATER WORK WINDOWS AND DESCRIPTIONS FOR FOUR CENTRAL VALLEY MANAGEMENT UNITS (MUS)

INCLUDES: WATERBODY, SPATIAL EXTENT - RIVER KILOMETERS (RKMS), ESU AND DPSS PRESENT, AND LIFE STAGES PRESENT.
W = WINTER-RUN, S = SPRING-RUN, ST = STEELHEAD, AND GS = GREEN STURGEON.

MU	Waterbody (s)	Applicable River Kilometer (RKM)	ESU/DPS	Non-Migratory	Migratory	Description	Work Window
1	Sacramento R.	>391[1]	W	✓	✓	Upper Sacramento R. with W and GS holding and spawning and S and ST spawning.	Oct 1 – Feb 15
			S	✓	✓		
			ST	✓	✓		
			GS	✓	✓		
2	Sacramento R.	>333, ≤391[2]	W		✓	Sacramento R. with GS holding and spawning, ST spawning, but below W and S spawning.	Jul 15 – Oct 31
			S		✓		
			ST	✓	✓		
			GS	✓	✓		
3	Sacramento R. Sacramento R. Tributaries w/o S San Joaquin R. San Joaquin R. Tributaries	≤333[2] Entire Length ≤414[5] Entire Length	W[3]		✓	Lower Sacramento R. and Sacramento R. tributaries with ST spawning, but no S spawning. San Joaquin R. mainstem with ST spawning, but below S spawning. San Joaquin R. tributaries with ST spawning, and potential S spawning.	Jun 1 – Oct 31
			S		✓		
			ST	✓	✓		
			GS[3]		✓		
4	San Joaquin River Sacramento R. Tributaries with S[4]	>414[5] Entire Length	W			Upper San Joaquin R. and Sacramento R. tributaries with S spawning.	Jul 15 – Sep 30
			S	✓	✓		
			ST	✓	✓		
			GS	✓	✓		

NOTES: [1]Kilam 2012, [2]Poytress et al. 2013, [3]Sacramento River Basin only, [4] Includes Mill Creek, Deer Creek, Butte Creek, Battle Creek, Clear Creek, Cottonwood Creek, Antelope Creek, Big Chico Creek, Yuba River, Feather River, [5] Gordon and Greimann 2014

Management Unit 1

Management Unit 1 encompasses the uppermost portion of the Sacramento River mainstem, which provides habitat for spawning for all listed ESUs. NOAA RC defined the downstream extent of MU 1 as 391 RKM, the most downstream observation of winter-run Chinook salmon spawning during historical aerial flight redd surveys (CDFW 2015). The in-water work window for MU 1 is defined as October 1 – February 15 to avoid the holding, spawning, and incubation life stages for winter-run Chinook salmon.

Management Unit 2

Management Unit 2 encompasses a portion of the Sacramento River mainstem that is downstream of winter-run and spring-run Chinook salmon spawning habitat, but provides spawning habitat for green sturgeon and steelhead. NOAA RC defined the downstream extent in the mainstem Sacramento River as 333 RKM, the most downstream observation of green sturgeon spawning during historical spawning surveys (Poytress et al. 2013). The majority of the dry summer and early fall period avoids the non-migratory life stages of steelhead and green sturgeon. However, the month of June was not included because green sturgeon can spawn through June (NMFS 2015b) . A summer/fall work window also avoids spawning of steelhead in the Sacramento River during winter and spring. Therefore, the in-water work window in MU 2 is defined as July 15 – October 31.

Management Unit 3

Management Unit 3 encompasses habitat in the lower Sacramento River (≤ 333 RKM), in Sacramento River tributaries without spring-run Chinook salmon spawning, in the San Joaquin River downstream of spring-run Chinook salmon spawning, and in San Joaquin river tributaries. The lower Sacramento River is downstream of green sturgeon and winter-run Chinook salmon spawning, with only steelhead spawning habitat present in this reach (occurring in the winter and spring months). The San Joaquin River tributaries support spawning habitat for steelhead in the winter and spring months, with reports (Franks 2014) that spring-running Chinook salmon may be present in the Stanislaus and Tuolumne rivers. Additionally, reintroduced spring-run Chinook salmon are expected to spawn in the uppermost reaches of the mainstem San Joaquin River below Friant Dam. Therefore, the in-water work window is defined to avoid late fall through spring months and is defined as June 1 – October 31. However, because of the possibility of spring-run Chinook salmon and early-arriving adult steelhead presence in San Joaquin River tributaries in October, in-water construction occurring during October in San Joaquin River tributaries must be approved by NMFS on a case-by-case basis. The project applicant must provide NMFS with detail on proposed species protection measures to minimize any potential incidental take.

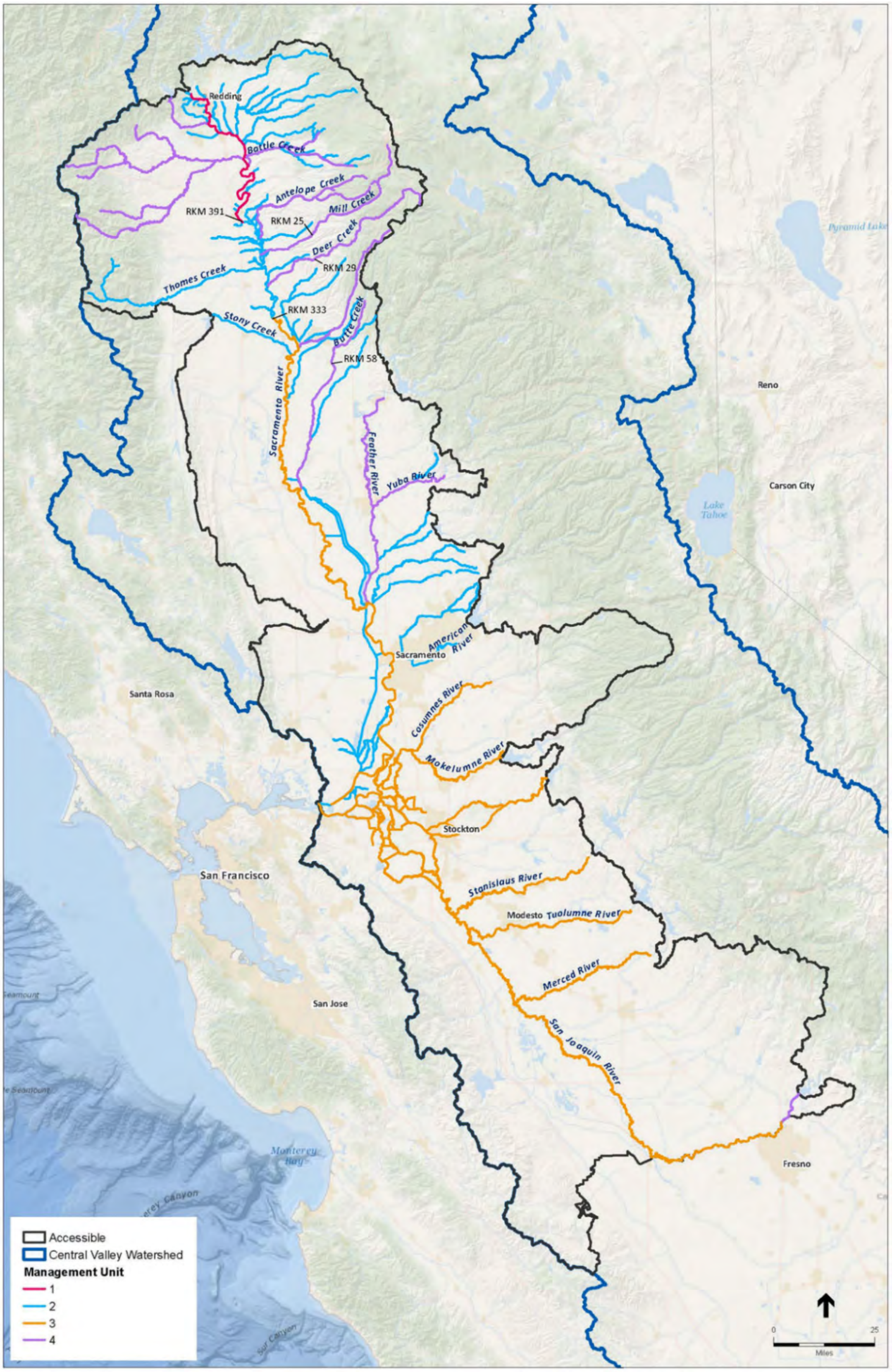


Figure 1-1: Central Valley Management Units (MUs)

Management Unit 4

Management Unit 4 encompasses spring-run Chinook salmon spawning and holding habitat in the San Joaquin River mainstem and Sacramento River tributaries that support spring-run Chinook salmon spawning. A spawning habitat suitability study conducted by Gordon and Greimann (2014) identified the first 16 KM downstream of Friant Dam on the San Joaquin River (> 414 RKM) as suitable habitat for spring-run Chinook salmon spawning, with suitable depths, velocities, and water temperatures present during the summer holding and fall spawning periods. The month of October is excluded from the in-water work window to avoid incubating spring-run Chinook salmon eggs. Therefore, the in-water work window is defined as July 15 – September 30.

Limits to Area of Disturbance for Individual Projects

Stream Dewatering During In-water Work Windows

In stream reaches where anadromous fish are expected to be present during construction, when practicable, complete dewatering of the channel cross-section will be avoided to maintain fish passage during construction. In cases where the entire channel cross-section must be dewatered, the maximum length of contiguous stream that can be dewatered is 1,000 feet (See also Sub-Section *General Measures to Limit the Effect of Dewatering Activities and Fish Relocation* in Section 1.3.6 for additional discussion on dewatering measures).

Upslope Disturbance (raw dirt, tree removal, canopy cover reduction)

The disturbance footprint for any individual project staging area may not exceed 0.50 acres.

Native trees with defects (snags, cavities, leaning toward stream channel, nests, late seral characteristics) >16 in. diameter at breast height (dbh) will be retained. All other trees >36 in. dbh will be retained. In limited cases, removal will be permitted if trees/snags are growing in culvert fill and need to be removed during a crossing upgrade or removal. The removal of exotic, invasive riparian vegetation in a stream prone to high water temperatures will be done in a manner to avoid creation of additional temperature loading to fish-bearing streams (See also Sub-Section *General Measures to Limit the Effect of Vegetation/Habitat Disturbance* in Section 1.3.6 for additional discussion on vegetation removal and replanting measures).

1.3.5 Covered Project Types and Prohibited Activities

All projects that are covered by the Program must meet the criteria of a restoration project where they must result in a net increase in aquatic or riparian resource functions and services and must remain consistent with NMFS Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014). Proposed restoration projects are categorized as follows: instream habitat improvements; barrier modification for fish passage improvement; bioengineering and riparian habitat restoration; upslope watershed restoration; removal of small dams (permanent, flashboard and other seasonal-type); fish screen installation, operation and maintenance; creation of off-channel/side-channel habitat; invasive plant removal and revegetation to improve fish and wildlife habitat; wetland and tidal marsh restoration and enhancement; piling and other instream structure removal to benefit water quality and habitat; and water conservation and streamflow augmentation projects to improve in-stream flow conditions for fish. Projects that will not be authorized under this program include water diversion or bypass flow requirements, flow operations from dams, large construction projects, or other projects requiring take authorization that are not specific to NOAA RC restoration proposed actions described below.

Covered Activities Described in the NMFS Guidelines and CDFW Manual

Habitat restoration projects authorized through the Program will be designed and implemented consistent with techniques and minimization measures presented in CDFW's *Manual*, Third Edition, Volume II with four chapters (Part IX: Fish Passage Evaluation at Stream Crossings, Part X: Upslope Assessment and Restoration Practices, Part XI: Riparian Habitat Restoration, and Part XII: Fish Passage Design and Implementation) added in 2003, 2004, and 2009, respectively (Flosi et al. 2010); *NMFS Crossing Guidelines* (NMFS 2001); and *NMFS Screening Guidelines* (NMFS 1997). The Program requires standard limits on the timing and area of disturbance for all projects in order to reduce the potential for ancillary effects to listed species and other riparian and aquatic species. These measures are described in the Section 1.3.4, *Programmatic Sideboards and Other Program Requirements*. Some activities also have additional project-specific minimization measures, which are listed following the description of the activity. Program activities (or project types) and related project specific minimization measures are described below.

Instream Habitat Structures and Improvements

Instream habitat structures and improvements are intended to provide predator escape and resting cover, increase spawning habitat, improve migration corridors, improve pool to riffle ratios, and add habitat complexity and diversity. Specific techniques for instream habitat improvement are described in the CDFW Salmonid Stream Habitat Restoration Manual, which includes, but is not limited to: (1) placement of cover structures (divide logs, engineered log jams, digger logs, spider logs; and log, root wad, and boulder combinations), boulder structures (boulder weirs, vortex boulder weirs, boulder clusters, and single and opposing boulder-wing-deflectors); (2) log structures (log weirs, upsurge weirs, single and opposing log-wing-deflectors, engineered log jams, and Hewitt ramps); (3) placement of imported spawning gravel; and (4) manipulation or removal of bank armoring or larger-caliber bed and bank material (i.e., revetment). Implementation of these types of projects may require the use of heavy equipment (e.g., self-propelled logging yarders, excavators, backhoes, helicopters).

Large woody material (LWM) may also be placed in the stream channel to enhance pool formation and increase stream channel complexity. Projects may include both anchored and unanchored logs, depending on site conditions and wood availability.

Creation of beaver habitat and installation of beaver dam analogue structures may also be done, including installation of in-stream structures to encourage or simulate beaver dam building.

Barrier Modification for Fish Passage Improvement

Barrier modification projects are intended to improve anadromous fish passage by (1) providing access to upstream habitat, (2) improving access to habitat, and (3) increasing the duration of accessibility (both within and between years). Projects may include those that improve fish passage through existing culverts, bridges, and paved and unpaved fords through replacement, removal, or retrofitting. In particular, these practices may include the use of gradient control weirs upstream or downstream of barriers to control water velocity, water surface elevation, or provide sufficient pool habitat to facilitate jumps, or interior baffles or weirs to mediate velocity and the increased water depth. Weirs may also be used to improve passage in flood control channels (particularly concrete lined channels). The Program also includes logjam modifications to facilitate juvenile and adult fish passage as well as construction, improvement and maintenance of fish ladders/fishways. The Program only applies to the fish passage facility/component of the weir, rather than the entire operation of the weir. Implementing these types of projects may require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes); however, hand labor will be used when possible.

Bioengineering and Riparian Habitat Restoration

These projects are intended to improve salmonid habitat through increased stream shading intended to lower stream temperatures, increased future recruitment of LWM to streams, and increased bank stability and invertebrate production. Riparian habitat restoration projects will increase the number of plants and plant groupings, and will include the following types of projects: natural regeneration, livestock exclusionary fencing, bioengineering, and revegetation. Part XI of the CDFW Manual, Riparian Habitat Restoration, contains examples of these techniques.

Reduction of instream sediment will improve fish habitat and fish survival by increasing fish embryo and alevin survival in spawning gravels, reducing injury to juvenile salmonids from high concentrations of suspended sediment, and minimizing the loss of, or reduction in size of, pools from excess sediment deposition. The proposed activities are expected to reduce stream sedimentation from bank erosion by stabilizing stream banks with appropriate site-specific techniques including: boulder-streambank stabilization structures, log-streambank stabilization structures, tree revetment, native plant material revetment, willow wall revetment, willow siltation baffles, brush mattresses, checkdams, brush checkdams, water bars, and exclusionary fencing. Guidelines for stream bank stabilization techniques are described in Part VII of the CDFW Manual, Project Implementation. These types of projects usually require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes).

Per Section 1.3.6, *Protection Measures*, when bioengineering bank stabilization options are not feasible due to site conditions, the amount of rock and other structural materials used for stream bank protection shall be limited to the minimum needed for scour protection.

Upslope Watershed Restoration

Upslope watershed restoration projects are intended to reduce excessive delivery of sediment to anadromous salmonid streams. Part X of the CDFW Manual, Upslope Assessment and

Restoration Practices, describes methods for identifying and assessing erosion, evaluating appropriate treatments, and implementing erosion control treatments. Road-related upslope watershed restoration projects will include: road decommissioning, upgrading, and storm proofing.

Implementation of these types of projects may require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes); however, hand labor will be used when possible.

Removal of Small Dams (permanent, flashboard and other seasonal-type)

Small dam removal is conducted to restore fisheries access to historic habitat for spawning and rearing and to improve long-term habitat quality and proper stream geomorphology. Types of eligible small dams include permanent, flashboard, debris basin, earthen and seasonal-type dams with the characteristics listed below. Although the CDFW Manual does not cover the removal of small dams, guidelines and minimization measures have been developed in this Program. Implementing these types of projects may require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes, etc.). Where appropriate, dams removed by the use of explosives are covered under this programmatic consultation provided that the appropriate sideboards (listed below) are applied.

Small dams included in the Program are those considered by the California Division of Dam Safety as non-jurisdictional sized dams, which are smaller in height or impounding capacity than those defined by the California Water Code where:

> *"Dam" means any artificial barrier, together with appurtenant works, which does or may impound or divert water, and which either (a) is or will be 25 feet or more in height from the natural bed of the stream or watercourse at the downstream toe of the barrier, as determined by the department, or from the lowest elevation of the outside limit of the barrier, as determined by the department, if it is not across a stream channel or watercourse, to the maximum possible water storage elevation or (b) has or will have an impounding capacity of 50 acre-feet or more* (California Water Code sec. 6002).

For the purpose of this Program, "small dams" are those dams that are either (a) less than 25 feet in height from the natural bed of the stream or (b) designed to have an impounding capacity of less than 50 acre-feet.

In addition, this Program will only include dam removal that will form a channel at natural grade and shape upstream of the dam, naturally or with excavation, in order to minimize negative effects on downstream habitat. Small dam removal projects will (1) have a relatively small volume of sediment available for release (relevant to the size of the stream channel, that when released by storm flows, will have minimal effects on downstream habitat as verified by a qualified engineer and reviewed by a NMFS engineer prior to project initiation) that, when released by storm flows, will have minimal effects on downstream habitat or (2) will be designed to remove sediment trapped by the dam down to the elevation of the target thalweg including design channel and floodplain dimensions. This can be accomplished by estimating the natural thalweg using an adequate longitudinal profile (CDFW Manual Part XII Fish Passage Design and Implementation) and designing a new, natural shaped channel that provides the same hydraulic conditions and habitat for listed fish that is provided by the natural channel and has the capacity to accommodate low flows. The channel itself will have a larger capacity to handle flood flows.

One of two methods will be used to restore the channel in a small dam removal project: 1) natural channel evolution or 2) "stream simulation" design. The conditions under which each of these methods may be used are as follows:

Natural channel evolution: The natural channel evolution approach to restoring a channel bed consists of removing all hardened portions (by hand efforts, heavy equipment, or explosives) of a dam and allowing the stream's flows to naturally shape the channel through the project reach over time. This method shall only be used in the following situations: (1) risks are minimal (or all risks can be mitigated) to any of the downstream habitats and the aquatic organisms inhabiting them (based upon the amount and size gradation of the material being stored above the dam) if all of the sediment upstream of the dam is released during a single storm event; (2) the project reach has sufficient space and can be allowed to naturally adjust based upon any land constraints with minimal risk to riparian habit; and 3) when possible, project implementation should follow procedures that have been documented as having been successfully performed elsewhere under similar circumstances. Notching the dam in increments after periodic storm events in order to reduce the amount of sediment being released during any individual storm event shall not be permitted unless project funding is sufficient to allow the dam to be completely removed within the proposed project timeframe.

Stream simulation: Stream simulation design relies upon trying to duplicate the morphological conditions observed within a natural reference reach throughout the project reach. Stream simulation designs should be used in extreme situations where excessive sediment releases pose a threat to downstream habitat and organisms. Specifically, the sediment upstream of the dam will be physically removed and the channel through the excavated reach will be designed using stream simulation. Stream simulation designs shall be conducted in accordance with known stream restoration and fish passage guidance documents. This specifically includes: (1) the identification of a suitable reference reach; (2) quantification of the average cross-sectional shape, bank full width, bed and bank sediment grain size distributions, and the geomorphic features of the channel (e.g., pool-riffle sequences, meander lengths, step pools, etc.); and (3) reproducing the geomorphic features found within the reference reach in the project reach.

Data Requirements and Analysis:

- A longitudinal profile of the stream channel thalweg for at least a distance equal to 20 channel widths upstream and downstream of the structure and long enough to establish the natural channel grade, whichever is farther, shall be used to determine the potential for channel degradation (as described in the CDFW Manual).

- A minimum of five cross-sectional profiles: one downstream of the structure, three roughly evenly spaced through the reservoir area upstream of the structure, and one upstream of the reservoir area outside of the influence of the structure to characterize the channel morphology and quantify the stored sediment.

- Sediment characterization within the reservoir and within a reference reach of a similar channel to determine the proportion of coarse sediment (>2mm) in the reservoir area and target sediment composition.

- A habitat typing survey (CDFW Manual Part III, Habitat Inventory Methods) that maps and quantifies all downstream spawning areas that may be affected by sediment released by removal of the water control structure.

Project-specific Minimization Measures

Use of Explosives for Small Dam Removal: Any use of explosives for small dam removal must be justified due to site-specific conditions including equipment access difficulties. Explosives use must be conducted in dry or dewatered conditions and potential harm to salmon and steelhead from the explosives blast and pressure waves must be analyzed.

Turbidity Measures: To minimize effects to aquatic species, stream diversions shall be in place for the shortest duration necessary to complete in-stream project activities.

Projects may be deemed ineligible for the Program if (1) sediments stored behind dam have a reasonable potential to contain environmental contaminants [dioxins, chlorinated pesticides, polychlorinated biphenyls, or mercury] beyond the freshwater probable effect levels summarized in the NOAA Screening Quick Reference Table guidelines or (2) the risk of significant loss or degradation of downstream spawning or rearing areas by sediment deposition is considered to be such that the project requires more detailed analysis. Sites shall be considered to have a reasonable potential to contain contaminants of concern if they are downstream of historical contamination sources such as lumber or paper mills, industrial sites, or intensive agricultural production going back several decades (i.e., since chlorinated pesticides were legal to purchase and use). Preliminary sediment sampling is advisable in these areas to determine if a project would be eligible for the Program.

See additional discussion of "*More Complex Projects Requiring Additional Oversight and Engineering Review by NMFS*" in this section.

Fish Screens

This category of project includes the installation, operation, and maintenance of the types of fish screens described below, provided they meet current NMFS (1997) fish screening criteria and are consistent with the NMFS' (2011c) anadromous salmonid passage facility design. Installing a fish screen usually includes site excavation, forming and pouring a concrete foundation and walls, pile driving, excavation and installation of a fish bypass pipe or channel, and installation of the fish screen structure. Heavy equipment is typically used for excavation of the screen site and bypass.

See additional discussion for, "*More Complex Projects Requiring Additional Oversight and Engineering Review by NMFS*" in this section.

If the fish screen is placed within or near flood prone areas, typically rock or other armoring is installed to protect the screen. Fish screen types include:

- Self-cleaning screens, including flat plate self-cleaning screens, and other self-cleaning designs, including, but not limited to, rotary drum screens and cone screens, with a variety of cleaning mechanisms, consistent with NMFS guidelines (NMFS 1997, 2011c).
- Non-self-cleaning screens, including tubular, box, and other screen designs consistent with NMFS screening criteria (NMFS 1997, 2011c).

Project-specific Minimization Measures

Diversion of Flows: All flows will be diverted around work areas as described in the Requirements for Fish Relocation and Dewatering Activities.

Fish Relocation: Fish removal may be required at project sites and best management practices will be implemented as described in the Requirements for Fish Relocation and Dewatering Activities.

Disturbance of Riparian Vegetation: Riparian disturbance will be minimized as described in the Measures to Minimize Loss or Disturbance of Riparian Vegetation.

Covered Activities Not Described in the NMFS Guidelines and CDFW Manual

Creation of Off-channel/Side Channel Habitat

The creation of off-channel or side channel habitat is not included in the CDFW Manual, however, guidelines and minimization measures have been developed for the Program. Types of side channel or off-channel restoration projects that will be eligible for the Program are:

- gravel augmentation occurring as part of the creation of side channel or off-channel habitats;
- connection of abandoned side channel or pond habitats to restore fish access;
- connection of adjacent ponds, remnants from aggregate excavation;
- connection of oxbow lakes on floodplains that have been isolated from the meandering channel by river management schemes, or channel incision;
- creation of side channel or off-channel habitat with self-sustaining channels; and
- improvement of hydrologic connection between floodplains and main channels;
- floodplain restoration to improve wildlife habitat and water quality.

Projects that involve the installation of a flashboard dam, head gate or other mechanical structure are not part of the Program. Managed surrogate floodplain and managed returned flows that require manual ingress and egress of juvenile salmonids are also not included under this Program and will be reviewed under an individual project section 7 consultation. Off-channel ponds constructed under this Program will not be used as a point of water diversion. Use of logs or boulders as stationary water level control structures will be allowed.

Restoration projects in this category may include removal or breaching of levees and dikes, channel and pond excavation, creating temporary access roads, constructing wood or rock tailwater control structures, and construction of LWM habitat features. Projects may also include installation, replacement, and relocation of irrigation canals, structures, utilities and appurtenant structures; and reconstruction of existing stream channels through excavation and structure placement or relocation. Implementation of these types of projects may require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes, front-loaders, etc.).

Information regarding consideration of water supply (channel flow/overland flow/groundwater), water quality, and reliability; risk of channel change or dissociation that could lead to stranding; as well as channel and hydraulic grade will be provided in the project proposal. If a proposed project requires extensive additional engineering analysis, the project should follow the criteria found in the sub-section "*More Complex Projects Requiring Additional Oversight and Engineering Review by NMFS*" and may be considered for individual section 7 consultation.

Invasive Plant Removal and Revegetation to Improve Fish and Wildlife Habitat

Invasive plant removal and revegetation to improve fish and wildlife habitat may include the employment of manual, mechanical, biological and chemical methods to remove invasive non-native plants. All of the available methods have inherent advantages and disadvantages that can also be specific to the project location and the invasive species being removed. Madsen (2000) identifies the most common plant removal techniques and best management practices for each. During NMFS project review the most appropriate techniques will be considered given the project and species limitations. These efforts may be stand-alone or associated with planting of native riparian vegetation. Predator control is not included under the proposed action.

Project-specific Minimization Measures

The following measures regarding insecticide, herbicide, and other chemical application shall be adhered to as explained below and in sub-section "*Vegetation and Habitat Disturbance*" found in Section 1.3.6, *Protection Measures*.

- Application of chemicals must be done by qualified individuals and application must be designed to reduce impact to non-target species and surface waters.
- To the greatest extent feasible, herbicides will be applied directly to target species by backpack sprayer or hand application to minimize exposure to non-target species and reduce the risk of herbicide drift.
    - For broadcast application, a minimum of 100-foot buffer from the water's edge shall be employed.

  - For backpack spraying and bottle spray application, a minimum 15-foot buffer from the water's edge shall be employed.
  - Within 15 feet of the water's edge, only hand application (i.e., wicking, wiping, and injections) shall be used.

- Chemical use is restricted in accordance with approved application methods and best management practices designed to prevent exposure to non-target areas and organisms. Any chemical considered for control of invasive species must adhere to all regulations, be approved for use in California and be applied by a licensed applicator under all necessary state and local permits.

- Only chemicals approved for aquatic use will be used on the waterside of a levee.

- A nontoxic biodegradable dye/spray pattern indicator shall be added to the spray tank whenever possible, as visual aide to track application.

- The preferred method of application is on the root base of individual plants targeted for irradiation rather than blanket application over a large area, and application well before the seeding season of a noxious plant begins.

- Methods that do not require surfactants/adjuvants will be used whenever possible. In situations where surfactants are necessary, products used will be limited to those determined to be the least toxic to aquatic and marine/estuarine organisms.

- Herbicides shall only be applied by persons who have all certificates and licenses required by the relevant state and/or county. Licensed Applicators shall follow all federal, state and local regulations regarding herbicide use.

- Any herbicides will be transported to and from the worksite in tightly sealed waterproof carrying containers. The licensed Applicator shall carry a kit for emergency spills. Should a spill occur, people will be kept away from affected areas until the clean-up is complete.

- Herbicide applications shall be timed to maximize favorable weather conditions. To avoid herbicide drift and potential non target impacts, spray herbicides shall be applied when wind speeds are less than 10 mph or according to the label directions, whichever is more restrictive/requires a lower wind speed for application. The length of time required between herbicide application and rainfall, referred to as the rainfast period, varies for different herbicides. The licensed Applicator shall follow recommendations for restrictions related to rainfall or ground moisture for each herbicide used. In addition, herbicides shall not be applied when rain is forecasted to occur within 24 hours or during a rain event.

- The licensed Applicator shall keep a record of all plants/areas treated, amounts and types of herbicide used, and dates of application. Site conditions to be considered include accessibility, proximity to open water, depth to groundwater, the presence of rare species and other conservation targets, and the site's sensitivity to trampling that could occur when the herbicide is being applied.

In addition, the licensed Applicator shall also adhere to conservation measures for herbicide application described below (Tu et al. 2001):

1. All application equipment must be calibrated.
2. Field scouting and monitoring must be done before herbicide application.
3. Herbicide-free buffers around sensitive areas shall be created, where feasible
4. The lowest legal effective application rate of herbicide shall be used.
5. Vegetative buffers shall be used to minimize offsite movement of herbicides.

Wetland and Tidal Marsh Restoration and Enhancement

Wetland and tidal marsh restoration and enhancement may include, but are not limited to: excavation, transfer, or import and contouring of sediment to sites to achieve appropriate tidal elevations that replicate natural inundation cycles. Projects may include levee, berm and dike setbacks and removal to activate disconnected surfaces and restoration of tidal flows onto marsh plains and mud flats. The project type may also include reconnecting or creating tidal and fluvial channels, removal of existing drainage structures, such as drain tiles, constructing small nesting islands; constructing open water areas; construct oyster habitat over unvegetated bottom in tidal waters and plowing or discing for seed bed preparation and the planting of appropriate wetland species. Freshwater marsh restoration will generally consist of actions involving grading (e.g., creating depressions, berms, and drainage features) to create topography that supports native marsh plants (planted or recruited naturally), provides habitat elements for target species, and allows fish and other aquatic species to exit if waters recede.

Riparian Habitat Restoration and Enhancement

Riparian uplands will be planted with native woody and herbaceous species such that it creates an ecosystem function equal to or greater than pre-project conditions. Following initial control of weeds, a seed mix of native riparian grasses, sedges, and wildflowers may be applied in areas at appropriate elevations. If soils are very compacted or low in nutrients, the soils may be amended with slow release fertilizer prior to planting. Cuttings from native riparian trees and shrubs could be collected from the project vicinity and installed in the riparian zones. Riparian trees and shrubs could also be field grown and transplanted in the winter as bare root stock, as appropriate.

Weed control may be implemented at least one year before planting and could include application of herbicides, mechanical disking, and mowing, as appropriate. Preference would be given to disking or mowing, but if slopes are too steep (e.g., greater than 3:1), or if existing planted vegetation is in the way, herbicide application may be necessary. For each new or replaced riparian planting, the plantings will be irrigated for up to three years during the dry part of the year, as necessary based on the plant type and local conditions, with a drip irrigation system connected to existing irrigation pumps retrofitted with fish screens. Maintenance of riparian plantings will use adaptive management practices to help ensure that the success of re-planting will be at a level expected to maintain or enhance ecosystem functions.

Piling and Other Instream and Bank Structure Removal to Benefit Water Quality and Habitat

Legacy piling and other instream and bank structure removal to benefit water quality and habitat may be implemented utilizing mechanical techniques, including the use of cranes, excavators and vibratory pile drivers (for purposes of removal).

Water Conservation and Streamflow Augmentation Projects to Improve In-stream Flow Conditions for Fish

Water conservation and streamflow augmentation projects to improve instream flow conditions for fish includes streamflow augmentation, developing off-stream water storage, creating tailwater collection ponds, and installing water storage tanks and associated piping.

Developing Alternative Stockwater Supply: Many riparian fencing projects will require the development of off-channel watering areas for livestock. These are often ponds that have been excavated and are filled either by rainwater, overland flow, surface diversions or groundwater (either through water table interception or pumping). The Program also covers water lines, watering troughs, and piping used to provide groundwater to livestock.

Project-specific Criteria for Eligibility

Only projects with existing diversions compliant with water laws will be considered. In addition, storage reservoirs will have an impounding capacity not to exceed 10 acre-feet per year. Flow measuring device installation and maintenance may be required for purposes of accurately measuring and managing pumping rate or bypass conditions set forth in the water right or special use permit.

Project-specific Minimization Measures

- All pump intakes will be screened in accordance with NMFS (1997) "Fish Screening Criteria for Salmonids" and guidance on "Anadromous Salmonid Passage Facility Design" (NMFS 2011c).

- Stockwater ponds and wells will be located at least 100 feet from the edge of the active channel and are not likely to cause stranding of juvenile salmonids during flood events.

Livestock Fencing, Stream Crossings and Off-Channel Watering to Improve In-stream Water Quality and Flow Conditions: Livestock fencing, stream crossings and off-channel watering to improve in-stream water quality and flow conditions may be implemented in areas where livestock have access to streams and rivers.

Tailwater Collection Ponds: Tailwater is created in flood irrigation operations as unabsorbed irrigation water flows back into the stream. Restoration projects to address tailwater input will construct tailwater capture systems to intercept tailwater before it enters streams. Water held in capture systems, such as a pond, can be reused for future irrigation purposes, therefore reducing the need for additional stream diversions.

Project-specific Minimization Measures

- Tailwater collection ponds that do not incorporate return channels to the creek will be located at least 100 feet from the edge of the active channel and are not likely to cause stranding of juvenile salmonids during flood events.

Water Storage Tanks and Off-stream Ponds Water storage tanks and ponds could either be filled through rainwater catchment or by surface or groundwater flow. Under this Program, all water storage tank and pond projects will be required to enter into a forbearance agreement for at least 10 years, which will provide temporal and quantitative assurances for pumping activities that result in less water withdrawal during summer low flow period. The low flow threshold proposed in the application will be based upon the season, local conditions, and existing studies if available. Water storage capacity for the water diversion forbearance period must be of sufficient capacity to provide for all water needs during that time period. For example, if the no-pump period is 105 days (August to November), the diverters must have enough storage to cover any domestic, irrigation, or livestock needs during that time.

Project-specific Minimization Measures

- All pump intakes will be screened in accordance with NMFS screening and passage criteria (NMFS 1997; 2011c).

- Water conservation projects that include water storage tanks or ponds with a Forbearance Agreement for the purpose of storing winter and early spring water for summer and fall use, require registration of water use pursuant to California Water Code § 1228.3, and require consultation with CDFW. Diversions to fill storage facilities during the winter and spring months shall be made pursuant to a Small Domestic Use Appropriation (SDU) filed with the State Water Resources Control Board (SWRCB).

Piping Ditches: Many diversions that flow from the point of diversion to the point of use through ditches are subject to leaks and evaporation. Piping projects consist of constructing a pipe to transport irrigation water instead of a ditch, thereby reducing evaporation and absorption. Water saved by these projects will remain in the stream for anadromous salmonid benefits. Applicants must demonstrate that they intend to dedicate water for instream beneficial use by filing a Petition for Instream Flow Dedication (California Water Code § 1707, 1991) and make progress towards instream dedication.

Project-specific Minimization Measures

- Only water conservation piping projects that result in a decrease in the diversion rate with a permitted instream dedication of the water saved are included in the Program.

- Landowners will enter an agreement with NOAA RC, USFWS or the Corps stating that they will maintain the pipe for at least 10 years.

More Complex Projects Requiring Additional Oversight and Engineering Review by NMFS

More complex project types covered by the Program will require a higher level of oversight (those with complex designs requiring engineering review) and review by NMFS regulatory agency staff and agency engineers. These project types will include: culvert retrofit and replacement projects; construction of new fish ladders/fish ways; retrofitting of older fish ladders/fishways; permanent removal of flash board dam abutments and sills; installation of fish screens; and placement of weirs in concrete lined channels.

Specific requirements associated with these more complex project types include the following:

- For stream crossing projects, the project must allow passage of the life stages and covered salmonid species historically passing there. Retrofit culverts shall meet the fish passage criteria for the passage needs of the listed species and life stages historically passing through the site prior to the existence of the road crossing according to NMFS Crossing Guidelines and CDFW stream crossing criteria (see Part XII of the CDFW Manual).

- All designs for fish ladders/fish ways and culvert replacement or modification projects must be reviewed and authorized by a NMFS (or CDFW) fish passage specialist prior to commencement of work.

- All designs for fish ladders/fish ways and culvert replacement or modification designs must be designed and stamped by an engineer registered in the State of California.

- All designs for fish ladders/fish ways shall follow the NMFS Anadromous Salmonid Passage Facility Design manual's fish ladder design guidelines (NMFS 2011c) including any subsequent updates to the manual.

- New ladders/fishways shall be constructed to provide passage conditions suitable for year round bidirectional adult and juvenile salmonid movement.

- New ladders will have a maximum vertical jump of six inches, unless NMFS guidelines are changed.

- Flow patterns in new ladders must be stable, with no water surges.

- Energy dissipation in new ladders should be complete in a step-and-pool fishway, with no carryover from pool to pool.

- Sediment composition and quantity, and effects of sediment transport must be evaluated by a qualified geomorphologist for all dam removal projects.

Prohibited Activities

The following activities are not within the scope of the NOAA RC, USFWS and Corps Restoration Program, and are not analyzed in this opinion. As such, the following projects, or projects with the following elements, will require separate consultation with NMFS:

- use of gabion baskets;
- use of cylindrical riprap (e.g., Aqualogs);
- use of undersized riprap (rock that will not remain in place during a 100-year flow event);
- permanent dams or construction of concrete lined channels of any sort;
- use of chemically-treated timbers used for grade or channel stabilization structures, bulkheads or other instream structures;
- activities substantially disrupting the movement of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the project footprint; (e.g. habitat projects without geomorphic and hydraulic modeling showing a low potential to divert aquatic life and/or leave aquatic life stranded);
- projects that would completely eliminate a riffle, pool, or riffle/pool complex[1];
- water diversions, not explicitly identified in this Section under "*Water Conservation and Streamflow Augmentation Project to Improve In-stream Flow Conditions for Fish*," to temporarily dewater a restoration project construction site, or small diversions used for the sole purpose of the drip-irrigation of restoration plantings;
- off-channel/side-channel habitat projects that require the installation of a flashboard dam, head gate or other mechanical structures;
- projects that have the potential to create a passage barrier for anadromous fish species as determined by NMFS Fish Passage guidelines (including any associated maintenance activities, or lack thereof);
- rock bank protection, other than the minimum amount needed as determined by NOAA RC in coordination with NMFS;
- installation of infiltration galleries;
- predator control projects; and

[1] There may be some instances where a riffle/pool complex is affected/modified by a restoration project (i.e., a culvert removal that affects an existing pool), these types of projects would be allowed under the Program.

- managed surrogate floodplain and managed returned flows that require manual ingress and egress of juvenile salmonids.

1.3.6 Protection Measures

In addition to the minimization measures included as part of individual projects, a number of protection measures have been incorporated into the Program such that these general conservation measures apply to all projects supported by the Program. The purpose of the protection measures is to incorporate design refinements and best practices into a project to avoid and/or minimize potential effects. These best practices tend to be relatively standardized; they represent sound and proven methods to reduce the potential effects of a given project. The rationale behind including these environmental commitments is that the Program's project applicant(s) will undertake and implement the applicable and necessary measures below as part of any proposed project. Although these best practices are required for all restoration projects authorized under the Program, during the administration process (Section 1.3.3) specific measures may be altered, added or removed on an individual project basis based upon site-specific conditions or technological constraints or advances, and with the approval of NMFS.

General Conservation Measures

- Work shall not begin until (a) the NOAA RC has notified the applicant that the requirements of the ESA have been satisfied and that the activity is authorized, and (b) all other necessary permits and authorizations are finalized. Prior to construction, any contractor shall be provided with the specific protective measures to follow during implementation of the project. In addition, a qualified professional, approved by NMFS, shall provide the construction crew with information on the protected species potentially found in the project vicinity, the protection afforded the species by the ESA and California Endangered Species Act, and guidance on those specific protection measures that must be implemented as part of the project.

- Water (e.g., trucks, portable pumps with hoses) shall be used to control fugitive dust during temporary access road construction with appropriate plans detailing watering amounts and schedule to produce sufficient dust control, waste-water run-off management measures, and planned water sources, as necessary.

- All materials placed in streams, rivers or other waters shall be nontoxic. Any combination of wood, plastic, cured concrete, steel pilings, or other materials used for in-channel structures shall not contain coatings or treatments or consist of substances toxic (e.g., copper, other metals, or pesticides, petroleum-based products, etc.) to aquatic organisms that may leach into the surrounding environment in amounts harmful to aquatic organisms.

- No materials shall be placed in any location or in any manner that would impair the flow of surface water into or out of any wetland area.

- Gravel, either obtained onsite or from a commercial source, will be appropriately screened (by size separator) prior to being placed in the river to avoid introduction of fine material. On-site gravels will be screened and sorted; gravels imported from a commercial source will be clean-washed and of appropriate size. Placement will be overseen by a qualified individual and implementation timing will be determined based on the least amount of overlap, or impact on, all sensitive resources that may be affected and the timing of their use of the receiving area.

- Water containing mud or silt from construction activities shall be treated by filtration or retention in a settling pond to avoid draining sediment-laden water back to the stream channel. Alternatively, an infiltration area may be created and used within the regular project footprint, if the soil composition of the area adequately supports infiltration back into the system.

- Screens shall be installed on all water pump intakes and other water diversions in compliance with NMFS salmonid-screening specifications.

- All refuse, debris, unused materials, equipment, and supplies that cannot reasonably be secured shall be removed daily from the project work area and deposited at an appropriate disposal or storage site. All trash and construction debris shall be removed from the work area immediately upon project completion.

- During project activities all trash, especially food-related refuse, that may attract potential predators of salmonids will be properly contained, removed from the work site, and disposed of daily.

- Construction materials such as portable equipment, vehicles, and supplies, including chemicals, shall be stored at designated construction staging areas and on barges, exclusive of any riparian or wetland areas. Any equipment that may leak shall be stored over impermeable surfaces, if available, and drip pans (or any other type of impermeable containment measure) will be placed under parked machinery and checked and replaced when necessary, to prevent drips and leaks from entering the environment.

- Where appropriate and practical, barges shall be used to stage equipment and construct the project to reduce noise and traffic disturbances and effects to terrestrial vegetation. When barge use is not practical, construction equipment and plant materials shall be staged in designated terrestrial areas adjacent to the project sites. Existing staging sites, maintenance toe roads, and crown roads shall be used to the maximum extent possible for project staging and access to avoid affecting previously undisturbed areas.

General Measures to Protect Water Quality and Limit Hazardous Materials

- Poured concrete shall be excluded from the wetted channel for a period of 30 days after it is poured. During that time, runoff from the concrete shall not be allowed to enter a live stream. Commercial sealants may be applied to the poured concrete surface where difficulty in excluding water flow for the 30-day period may occur. If sealant is used, water shall be excluded from the site until the sealant is dry and fully cured according to the manufacturer's specifications.

- Debris, soil, silt, excessive bark, rubbish, creosote-treated wood, raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to aquatic life, resulting from project related activities, shall be prevented from contaminating the soil or entering federal and state jurisdictional waters. Any of these materials, placed within or where they may enter a stream or lake, by the applicant or any party working under contract, or with permission of the applicant, shall be removed immediately.

- All mechanized equipment working in the stream channel or within 25 feet of a wetted channel shall have a double (i.e., primary and secondary) containment system for diesel and oil fluids. Hydraulic fluids in mechanical equipment working within the stream channel shall not contain organophosphate esters. Vegetable-based hydraulic fluids are preferred.

- The use or storage of petroleum-powered equipment shall be accomplished in a manner to prevent the potential release of petroleum materials into waters of the state.

- Areas for fuel storage, refueling, and servicing of construction equipment must be located in an upland location.

- Prior to use, all equipment shall be cleaned to remove external oil, grease, dirt, or mud. Wash sites must be located in upland locations so wash water does not flow into a stream channel or adjacent wetlands. All construction equipment must be in good working condition, showing no signs of fuel or oil leaks. Prior to construction, all mechanical equipment shall be thoroughly inspected and evaluated for the potential of fluid leakage. All mechanical equipment shall be inspected on a daily basis to ensure there are no motor oil, transmission fluid, hydraulic fluid, or coolant leaks. All leaks shall be repaired in the equipment staging area or other suitable location prior to resumption of construction activity. Equipment stored for a lengthy period of time (more than one week on site) shall have drip and leak pans placed underneath potential leak areas to contain accidental drips.

- Oil absorbent and spill containment materials shall be located on site when mechanical equipment is in operation within 100 feet of the proposed watercourse crossings. If a spill occurs, no additional work shall commence in-channel until (1) the mechanical equipment is inspected by the contractor, and the leak has been repaired, (2) the spill has been contained, and (3) NMFS and NOAA RC and/or the Corps are contacted and have evaluated the impacts of the spill. Absorbent and spill containment materials will otherwise be inspected regularly to ensure functionality.

- Effective erosion control measures shall be in place at all times during construction. Construction shall not start until all temporary control materials and devices (e.g., straw bales with sterile, weed-free straw, silt fences) are in place downslope or downstream of the work site within the riparian area. The materials shall be properly installed at all locations where the likelihood of sediment input exists. These materials shall be in place during and after construction activities for the purposes of minimizing fine sediment and sediment/water slurry input to flowing water and to detain sediment-laden water on site.

If continued erosion is likely to occur after construction is complete, then appropriate erosion prevention measures shall be implemented and maintained until erosion risk has subsided.

- Erosion control materials such as coir rolls or erosion control blankets will not contain plastic netting that could entrain reptiles (especially snakes) and amphibians.

- Sediment shall be removed from sediment control materials once it has reached one-third of the exposed height of the control, and placed in an upland location where it cannot be washed into federal or state jurisdictional waters.

- The contractor/applicant to the Program shall inspect, maintain and repair all erosion control materials and devices prior to and after any storm event, at 24-hour intervals during extended storm events, and a minimum of every two weeks until all erosion control measures are no longer needed. If an erosion control measure fails and sediment is discharged, appropriate agencies should be notified within 48 hours of discovery.

- Temporary stockpiling of material onsite shall be minimized. Any excavated material shall be stockpiled in areas a sufficient distance from watercourses, where it cannot enter the stream channel. Prior to start of construction, the contractor shall determine if such sites are available at or near the project location. If onsite or nearby sites are unavailable, a location will be determined where material can be deposited. Spoils shall be contoured to disperse runoff and stabilized with mulch and (native) vegetation. Materials such as plastic sheeting held down with rocks or sandbags over stockpiles, silt fences, and berms of hay bales, shall be used to minimize movement of exposed or stockpiled soils from wind or precipitation.

- If feasible, topsoil shall be conserved for reuse at project location or use in other areas. Spoils shall be end-hauled away from watercourses as soon as possible to minimize potential sediment delivery.

- Immediately after project completion and before close of seasonal work window, all exposed soil shall be stabilized with erosion control measures such as mulch, seeding, and/or placement of erosion control blankets. Where straw, mulch, or slash is used on bare mineral soil, the minimum coverage shall be 95 percent with two-inch minimum depth. All non-natural erosion control materials shall be removed after the project vicinity has fully stabilized. When seeding is used as an erosion control measure, only seeds from native plant species will be used. Sterile (without seeds), weed-free straw, free of exotic weeds, is required when hay or hay bales are used as erosion control measures.

- Precautions to minimize turbidity/siltation shall be taken into account during project planning and shall be implemented at the time of construction. This may require placing silt fencing, well-anchored sandbag or sheet pile cofferdams, temporary water bladder dams, coir logs, coir rolls, straw bale dikes, or other siltation barriers so that silt and/or other deleterious materials are not allowed to erode into downstream reaches. These barriers shall be placed at all locations where the likelihood of sediment input exists and shall be in place during construction activities, and afterward if necessary. If any sediment barrier fails to retain sediment, corrective measures shall be taken immediately.

General Measures to Limit the Effect of Instream Construction

- Where feasible, construction shall occur from the top of the stream bank, or on a temporary pad underlain with filter fabric.

- Use of heavy equipment shall be avoided, where possible, in a channel bottom with rocky or cobbled substrate. If access to the work site requires crossing a rocky or cobbled substrate, a rubber tire loader/backhoe shall be the preferred vehicle. Only after this option has been determined infeasible will the use of tracked vehicles be considered. The amount of time this equipment is stationed, working, or traveling within the creek bed shall be minimized. When heavy equipment is used, woody debris and vegetation on stream banks and in the channel shall not be disturbed if outside of the project's work area.

- When appropriate and with approval by NMFS, instream grade control structures may be utilized to control channel scour, sediment routing, and headwall cutting. Any such structures shall comply with NMFS fish passage guidelines.

- For relief culverts or structures, if a pipe or structure that empties flow from a non-fish bearing stream is installed, an energy dissipater shall be installed to reduce bed and bank scour. This does not apply to culverts or structures conveying flow that may be considered part of a fish-bearing stream. Any such structures shall comply with NMFS fish passage guidelines. The toe of rock slope protection used for streambank stabilization shall be placed sufficiently below the bed scour depth to ensure stability.

- When bioengineering bank stabilization options are not feasible due to site conditions, the amount of rock riprap and other structural materials used for stream bank protection shall be limited to the minimum needed for scour protection as determined by NOAA RC in coordination with NMFS. See Section 1.3.5 *Covered Project Types and Prohibited Activities* for more information on the bioengineering bank stabilization project type.

More detailed information on the timing of instream construction are listed above in "*In-water Work Windows*" of Section 1.3.4 *Programmatic Sideboards and Other Program Requirements*.

General Measures to Limit the Effect of Dewatering Activities and Fish Relocation

- In those specific cases where it is deemed necessary to work in flowing water, the work area shall be isolated and all flowing water shall be temporarily diverted around the work site to maintain downstream flows and both upstream and downstream fish passage during construction. The length of the dewatered stream channel and duration of dewatering, shall be minimized to the greatest extent practicable.

- As part of the initial submittal requirements, a dewatering and fish capture and relocation plan will be given to NMFS as an additional part of the project description, so that any activities involving the handling of protected fishes may be reviewed and modified if necessary (see "*Initial Project Screening*" Sub-Section in *Program Administration*).

- Fish shall be excluded from occupying the work area by blocking the stream channel above and below the work area with fine-meshed block nets or screens. Mesh will be no greater than 1/8-inch diameter. The bottom of a seine must be completely secured to the channel bed. Screens must be checked twice daily and cleaned of debris to permit free flow of water. Block nets shall be placed and maintained throughout the dewatering period at the upper and lower extent of the areas where fish will be removed. Block net mesh shall be sized to ensure salmonids upstream or downstream do not enter the areas proposed for dewatering. Net placement is temporary and will be removed once dewatering has been accomplished or construction work is complete for the day.

- Prior to dewatering, the best means to bypass flow through the work area shall be determined to minimize disturbance to the channel and avoid direct mortality of fish and other aquatic vertebrates. Project site dewatering shall be coordinated with a qualified biologist who will perform fish and amphibian relocation activities. The qualified biologist(s) must be familiar with the life history and identification of listed salmonids and listed amphibians within the action area. Prior to dewatering a construction site, the qualified biologist shall capture and relocate fish and amphibians to avoid direct mortality and minimize adverse effects. This is especially important if listed species are present within the project site. Visqueen-type material shall be placed over sandbags used for construction of cofferdams to minimize water seepage into the work area. Visqueen material shall be firmly anchored to the streambed to minimize water seepage. Coffer dams and stream diversion systems shall remain in place and fully functional throughout the construction period. When coffer dams with bypass pipes are installed, debris racks will be placed at the bypass pipe inlet. Bypass pipes will be monitored a minimum of two times per day, seven days a week. All accumulated debris shall be removed.

- Bypass pipes will be sized to accommodate, at a minimum, twice the expected baseflow. The work area may need to be periodically pumped dry of seepage. Pumps will be placed in flat areas, well away from the stream channel, and secured by tying off to a tree or stake in place to prevent movement by vibration. Pumps shall be refueled in an area well away from the stream channel and fuel absorbent mats will be placed under the pumps while refueling. Pump intakes shall be covered with mesh per the requirements of NMFS Fish Screening Criteria to prevent potential entrainment of fish or amphibians that could not be removed from the area to be dewatered. The pump intake shall be checked periodically for impingement of fish or amphibians. If pumping is necessary to dewater the work site, procedures for pumped water shall include requiring a temporary siltation basin for treatment of all water prior to entering any waterway and not allowing oil or other greasy substances originating from operations to enter or be placed where they could enter a wetted channel. All work shall comply with NMFS' screening and passage guidelines (NMFS 1997, 2011c).

- Sediment-laden water shall be filtered or discharged from the construction area to an upland location or settling pond where it will not drain back into the stream channel. The settling pond may act as an infiltration basin so that water can be returned to the stream system while sediment is captured.

- When construction is complete, the flow diversion structure shall be removed as soon as possible in a manner that will allow flow to resume with the least disturbance to the substrate. Cofferdams will be removed so surface elevations of water impounded above the cofferdam will not be reduced at a rate greater than one inch per hour. This will minimize the probability of fish stranding as the area upstream becomes dewatered.

- All seining, electrofishing, and relocation activities shall be performed by a qualified biologist. The qualified biologist shall capture and relocate listed species prior to construction of the water diversion structures (e.g., cofferdams). The qualified biologist shall note the number of listed species observed in the affected area, the number and species of fish relocated, where they were relocated to, and the date and time of collection and relocation. The qualified biologist shall have a minimum of three years' field experience in the identification and capture of listed species, including adult and juvenile salmonids, considered in this opinion. The qualified biologist will adhere to the following requirements for capture and transport of listed fish species:

    - Determine the most efficient means for capturing fish (e.g., seining, dip netting, trapping, and electrofishing). Complex stream habitat generally requires the use of electrofishing equipment, whereas in outlet pools, fish may be concentrated by pumping-down the pool and then seining or dip netting fish.

    - NMFS staff (identified as project contact) shall be notified one week prior to capture and relocation of listed fish to provide NMFS an opportunity to monitor the operation.

    - Initial fish relocation efforts will be conducted several days prior to the start of construction. This provides the biologist an opportunity to return to the work area and perform additional electrofishing passes immediately prior to construction. In many instances, additional fish will be captured that eluded the previous day's efforts.

    - In streams with high water temperature, perform relocation activities during morning periods, when water is coolest.

    - Prior to capturing fish, determine the most appropriate release location(s). Consider the following when selecting release site(s): similar water temperature as capture location, ample habitat for captured fish, low likelihood of fish reentering work site or becoming impinged on exclusion net or screen.

    - All electrofishing will be conducted according to NMFS *Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act* (2000).

- Water temperature, dissolved oxygen, and conductivity shall be recorded in an electrofishing log book, along with electrofishing settings.

- A minimum of one assistant shall aid the biologist by netting stunned fish and other aquatic vertebrates.

- The following methods shall be used if fish are removed with seines: A minimum of three passes with the seine shall be utilized to ensure maximum capture probability of salmonids within the area. All captured fish shall be processed and released prior to each subsequent pass with the seine. The seine mesh shall be adequately sized to ensure fish are not gilled during capture and relocation activities.

The following methods shall be used during relocation activities associated with either method of capture (electrofishing or seining) for salmonids:

- Salmonids shall not be overcrowded into buckets; no more than 150 0+ fish (approximately six cubic inches per young-of-the-year (0+) individuals approximately) shall be allowed per five-gallon bucket, and fewer individuals per bucket shall be allowed for larger fish.

- Every effort shall be made not to mix (0+) salmonids with larger salmonids or other potential predators. At least two containers shall be used to segregate (0+) fish from larger age classes. Larger amphibians shall be placed in the container with larger fish.

- Native salmonid predators collected and relocated during electrofishing or seining activities shall be relocated in a dispersive manner so as to not concentrate them in one area. Particular emphasis shall be placed on avoiding relocation of predators into steelhead and salmon relocation pools. To minimize predation on salmonids, relocated species shall be distributed throughout the wetted portion of the stream so as not to concentrate them in one area.

- All captured listed fish shall be relocated outside of the proposed construction site and placed in suitable habitat. Adults will be placed upstream and juveniles downstream of the construction site. Captured fish shall be placed into a pool, preferably with a depth of greater than two feet with available instream cover. Owners of the land adjacent to the relocation site shall be contacted and briefed of the activities, if at all possible.

- All captured listed fish will be processed and released prior to conducting a subsequent electrofishing or seining pass.

- All native captured fish will be allowed to recover from electrofishing before being returned to the stream.

- Handling of listed fish will be minimized to the greatest degree possible. When handling is necessary, hands or nets will always be wet prior to touching fish. Fish handlers will not wear DEET-based insect repellants.

- Temporarily hold fish in cool, shaded, aerated water in a container with a lid. Provide aeration with a battery-powered external bubbler. Protect fish from jostling and noise and do not remove fish from this container until time of release.

- Place a thermometer in holding containers and, if necessary, periodically conduct partial water changes to maintain a stable water temperature. If water temperature reaches or exceeds 18°C, fish shall be released and rescue operations ceased.

- In cases where aquatic vertebrates are especially abundant, periodically cease capture and release them at predetermined locations to ensure individuals are not contained for lengthy amounts of time.

- Visually identify species and estimate year-classes of fishes at time of release. Record the number of fish captured. Avoid anesthetizing or measuring fish.

- If more than 3 percent of the steelhead or Chinook salmon or a single green sturgeon captured are killed or injured, the project lead shall contact the NMFS California Central Valley Office. The purpose of the contact is to allow the agencies to review the activities resulting in incidental take and to determine if additional protective measures are required. All steelhead and Chinook salmon mortalities must be retained, placed in an appropriately sized whirl-pak or zip-lock bag, labeled with the date and time of collection, fork length, location of capture, and frozen as soon as possible. Frozen samples must be retained until specific instructions are provided by NMFS.

General Measures to Limit the Effect of In-water Pile Driving

Project applicants shall implement the following measures to avoid and minimize potential adverse effects that could otherwise result from in-water pile-driving activities:

- Project applicants shall develop a plan for pile-driving activities to minimize impacts to fish and will allow sufficient time in the planning and construction schedule for coordination with regulatory agencies. Measures will be implemented to minimize underwater sound pressure to levels below thresholds for peak pressure and accumulated sound exposure levels at a distance of ten meters. Threshold levels established by NMFS are:

peak pressure = 2	06 dB peak
accumulated sound exposure levels=	183 dB SEL

- The number of piles, type/size of the piles, estimated sound levels caused by the driving, how many piles will be driven each day, and any other relevant details on the nature of the pile driving activity must be included in the project application. See Section 1.3.3 *Program Administration* for further details on the project application process.

- If conditions allow, underwater sound monitoring shall be performed during pile-driving activities. Qualified personnel shall be present during such work to monitor construction activities and compliance with terms and conditions of permits or approvals.

- Pile driving shall occur during the established/approved in-water and general work windows.

- Sheet piling shall be driven by vibratory or nonimpact methods (i.e., hydraulic) that result in sound pressures below threshold levels to the extent feasible.

- Pile driving activities shall occur during periods of reduced currents. Pile-driving activities shall be monitored to ensure that the effects of pile driving on protected fish species are minimized. If any stranding, injury, or mortality to fish is observed, NMFS shall be immediately notified and in-water pile driving shall cease. Vibratory hammers, rather than impact hammers, shall be used whenever possible.

- Monitoring of fish shall occur during pile-driving activity to ensure no fish stranding or mortality occurs during the construction of the cofferdam (activities could include seining or snorkeling).

- Pile driving shall be conducted only during daylight hours and initially will be used at low energy levels and reduced impact frequency. Applied energy and frequency will be gradually increased until necessary full force and frequency are achieved.

- If it is determined that impact hammers are required and/or underwater sound monitoring demonstrates that thresholds are being exceeded, the contractor shall implement sound dampening or attenuation devices to reduce levels to the extent feasible; these may include the following:

    - A cushioning block shall be used between the hammer and pile.

    - A confined or unconfined air bubble curtain shall be used.

    - If feasible, pile driving could be done in the dry area (dewatered) behind the cofferdam.

General Measures to Limit the Effect of Vegetation/Habitat Disturbance

- Vegetation disturbance will be avoided and minimized to the extent practicable. Disturbed areas will be revegetated with native plant species appropriate to the site.

- Disturbance to existing grades and native vegetation shall be limited to the actual site of the project, necessary access routes, and staging areas. The number of access routes, the size of staging areas, and the total area of the project activity shall be limited to the minimum necessary to achieve the project goal. All roads, staging areas, and other facilities shall be placed to avoid and limit disturbance to streambank or stream channel habitat as much as possible. When possible, existing ingress or egress points shall be used and/or work shall be performed from the top of the creek banks or from barges on the waterside of the project levee. Following completion of the work, the contours of the creek bed and creek flows shall be returned to preconstruction conditions or improved to provide increased biological functions.

- If removal of vegetation is required within project access or staging areas, the disturbed areas shall be replanted with native species, and the area will be maintained and monitored for a period of two years after replanting is complete to ensure the revegetation effort is successful. The standard for success is 80 percent survival of plantings or 80 percent ground cover for broadcast planting of seed, after a period of two years. If revegetation efforts will be passive (i.e., natural regeneration), success will be defined as total cover of woody and herbaceous material equal to or greater than pre-project conditions. If at the end of 2 years, the vegetation has not successfully been re-established, the applicant will be responsible for replacement planting, additional watering, weeding, invasive exotic eradication, or any other practice, to achieve these requirements. If success is not achieved within the first two years, the project applicant will need to prepare a follow up report in an additional year's time.

- If erosion control fabrics are used in revegetated areas, they shall be slit in appropriate locations as necessary to allow for plant root growth. Only non-monofilament, wildlife-safe fabrics shall be used.

- To minimize ground and vegetation disturbance during project construction, prior to beginning project activities the applicant shall establish and clearly mark the project limits, including the boundaries of designated equipment staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; and equipment exclusion zones.

- As many trees and brush shall be retained as practicable, emphasizing the retention of shade-producing and bank stabilizing trees and brush with greater than 3-inch diameter branches or trunks.

- Prior to construction, locations and equipment access points will be determined to minimize riparian disturbance. Unstable areas will be avoided. Project designs and access points to be used should minimize riparian disturbance without affecting less stable areas, to avoid increasing the risk of channel instability.

- Soil compaction will be minimized by using equipment with a greater reach or that exerts less pressure per square inch on the ground than other equipment, resulting in less overall area disturbed or less compaction of disturbed areas.

- If riparian vegetation is to be removed with chainsaws, machines that operate with vegetable-based bar oil would be used, if possible.

- Any stream bank area left barren of vegetation as a result of the implementation or maintenance of the erosion control practices shall be restored to a natural state by seeding, planting, or other means with native trees, shrubs, or grasses prior to November

15 of the project year, or later depending on rainfall, with the approval of NMFS. Barren areas shall typically be planted with a combination of willow stakes, native shrubs and trees and/or erosion control grass mixes. Irrigation may also be required in order to ensure survival of containerized shrubs or trees.

- Native plant species shall be used for revegetation of disturbed and compacted areas. The species used shall be specific to the project vicinity or the region of the state where the project is located, and comprise a diverse community structure (plantings shall include both woody and herbaceous species).

- All plastic exclusion netting placed around plantings will be removed after 3 years.

- All invasive plant species (e.g., giant reed, tamarisk, *Arundo donax*, tree of heaven) shall, if feasible, be removed from the project site, destroyed using approved protocols, and disposed of at an appropriate upland disposal area.

For measures regarding chemical/herbicide application see the *"Invasive plant removal and revegetation"* Sub-Section, of Section 1.3.5 *Covered Project Types and Prohibited Activities.*

1.3.7 Monitoring and Reporting Requirements

The following monitoring and reporting requirements will be met by all Program applicants.

Pre-Project Monitoring Submittal Requirements

Individual project applicants will be required to submit a proposed monitoring plan for the project describing how they will ensure compliance with the applicable monitoring requirements described in this Program description (revegetation, etc.), including the source of funding for implementation of the monitoring plan. See Sub-Section "*Submittal Requirements"* of *Program Administration* (Section 1.3.3) for further information on pre-project submittal requirements.

Post-Construction Monitoring and Reporting Requirements

Applicants will also be required to fill out the Sacramento Office Programmatic Approach Post-Project Monitoring Form, which will be provided to applicants by the NOAA RC when their project is approved for the Program. In addition, see Sub-Section "*Submittal Requirements"* of *Program Administration* (Section 1.3.3) for further information on all application submittal requirements.

Implementation monitoring will be conducted for all projects implemented under the proposed Program. Following construction, individual applicants will submit a post-construction, implementation report to the NOAA RC. Submittal requirements will include project as-built plans describing post implementation conditions and photo documentation of project implementation taken before, during, and after construction utilizing CDFW photo monitoring protocols available on CDFW's website at https://www.wildlife.ca.gov/Conservation/Survey-Protocols. For fish relocation activities, the report will include all fisheries data collected by a qualified biologist including the number of listed salmonids killed or injured during the proposed action, the number and size (in millimeters) of listed salmonids captured and removed and any effects of the proposed action on listed salmonids and/or green sturgeon not previously considered. Applicant will work with the NOAA RC to update the NOAA database used for tracking salmonids killed or injured during a proposed action.

Monitoring Requirements for Off-channel/Side Channel Habitat Features

All off-channel/side channel habitat projects included in the Program will require additional physical and biological monitoring. In addition to the information collected during the pre-project monitoring and submittal requirements (above), the following information will also be collected by Program applicants and submitted to the NOAA RC:

- Pre- and post-project photo monitoring data (per CDFW's guidelines, and as described in Woodward and Hollar (2011));
- Project description, including
    - Project problem statement
    - Project goals and objectives, etc.
    - Watershed context
    - Description of the type of off-channel feature and restoration techniques utilized
    - Project dimensions
    - Description of outlet control feature (if present)
    - If dewatering of the work site will be necessary, description of temporary dewatering methods including qualified individual who will be onsite to transport protected salmonids
    - Construction start and end dates
    - Materials to be used
    - When vegetation is affected as a result of the project (including removal and replacement), a visual assessment of dominant native shrubs and trees, approximate species diversity, and approximate acreage
    - Description of existing site conditions and explanation of how proposed activities improve or maintain these conditions for Chinook salmon, steelhead, and/or green sturgeon move within the natural variability needed to support these species
    - Description of key habitat elements (i.e., temperature; habitat type: pool, riffle, flatwater; estimate of instream shelter and shelter components; water depth;

dominant substrate type, etc.) for Chinook salmon, steelhead, and/or green sturgeon in project vicinity

- Pre- and post-flow (after winter-flow event) information on the elevation of the inlet and outlet structure relative to the 2-year flood
- A description of if and when the off channel feature became disconnected from the main channel and at what flow level (cfs); this will require checking the project site daily when the off-channel feature is becoming disconnected from the main channel
- A description of any stranded fish observed; if salmonids or sturgeon are stranded, the applicant will contact NMFS immediately to determine if a fish rescue action is necessary.

Monitoring Schedule

Pre-project biological monitoring data should be collected at both the control and restoration sites in the year prior to project implementation in order to establish a project baseline. Fish and vegetation surveys and macroinvertebrate benthic and drift sample collection will occur multiple times during the spring and into the summer to capture full rearing and summer holding season. Snorkel surveys and sample benthic macroinvertebrates should be conducted at separate locations within a project footprint and at control locations.

Unless there is a very high flow event prior to restoration, pre-project physical habitat data (substrate and structural habitat mapping, bathymetry) may only need to be collected once, as these variables generally remain relatively stationary over a short time period, particularly if there are no high flow events.

Post-project monitoring following restoration ideally would be conducted for at least two years, and up to five years, subject to NOAA RC project review (depending on funding and/or project complexity), to increase the probability of capturing a range of environmental conditions. Longer-term monitoring of physical and biological habitat features over time and continued fish use of the restored habitat is recommended to determine the long-term sustainability of the site and whether additional actions are needed to maintain and improve off-channel habitat function. Less complex projects will be assessed for appropriate monitoring methods and timelines.

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

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

2.1 Analytical Approach

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

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

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

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

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors by: (1) reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.

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

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

The purpose of the jeopardy analysis is to determine whether appreciable reductions of both the survival and recovery of the species in the wild are reasonably expected, but not to precisely quantify the amount of those reductions. For this analysis, NMFS equates a listed species' probability (or risk) of extinction with the likelihood of both the survival and recovery of the species in the wild. In the case of listed salmonids, NMFS uses the Viable Salmonid Population (VSP) framework (McElhany et al. 2000) as a bridge to the jeopardy standard. A designation of "a high risk of extinction" or "low likelihood of becoming viable" indicates that the species faces significant risks from internal and external processes that can drive it to extinction.

To apply this framework approach to the assessment of the Program, special consideration is given to Program administration (described in Section 1.3.3) to provide reasonable assurance that individual projects that do not conform to the Program criteria are not included in the Program. This consideration is also made to acknowledge the inherent limitation of analyzing the action when there is relative uncertainty regarding the place, timing, number, and type of projects will be implemented under the Program. As a result, this assessment often focuses on whether or not an appreciable reduction is expected; it does not focus on detailed analyses designed to quantify the absolute amount of reduction or the resulting population characteristics (absolute abundance, for example) that could occur as a result of Program implementation.

2.2 Rangewide Status of the Species and Critical Habitat

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

2.2.1 Sacramento River Winter-run Chinook Salmon

- First listed as threatened (54 FR 32085; August 4, 1989).

- Reclassified as endangered (59 FR 440; January 4, 1994); reaffirmed as endangered (70 FR 37160; June 28, 2005).

- Designated critical habitat (58 FR 33212; June 16, 1993).

The federally listed evolutionary significant unit (ESU) of Sacramento River winter-run Chinook salmon and designated critical habitat for this ESU occur in the action area and may be affected by the proposed action. Detailed information regarding ESU listing and critical habitat designation history, designated critical habitat, ESU life history, and viable salmonid population (VSP) parameters can be found in the 5-Year Status Review of Sacramento River Winter-Run Chinook Salmon ESU (NMFS 2016c).

Historically, Sacramento River winter-run Chinook salmon population estimates were as high as 120,000 fish in the 1960s, but declined to less than 200 fish by the 1990s (NMFS 2011b). In recent years, since carcass surveys began in 2001, the highest adult escapement occurred in 2005 and 2006 with 15,839 and 17,296, respectively (CDFW 2018). However, from 2007 to 2013, the population has shown a precipitous decline, averaging 2,486 during this period, with a low of 827 adults in 2011 (CDFW 2018). This recent declining trend is likely due to a combination of factors such as poor ocean productivity (Lindley et al. 2009), drought conditions from 2007 to 2009, and low in-river survival rates (NMFS 2011b). In 2014 and 2015, the population was approximately 3,000 adults, slightly above the 2007 to 2012 average, but below the high (17,296) for the last 10 years (CDFW 2018).

The year 2014 was the third year of a drought that increased water temperatures in the upper Sacramento River, and egg-to-fry survival to the Red Bluff Diversion Dam (RBDD) was approximately 5 percent (NMFS 2016c). Due to the anticipated lower than average survival in 2014, hatchery production from Livingston Stone National Fish Hatchery (LSNFH) was tripled (i.e., 612,056 released) to offset the impact of the drought (CVP and SWP Drought Contingency Plan 2014). In 2014, hatchery production represented 83 percent of the total in-river juvenile production. In 2015, egg-to-fry survival was the lowest on record (approximately 4 percent) due to the inability to release cold water from Shasta Dam in the fourth year of a drought. As expected, winter-run Chinook salmon returns were a low in 2016 with 1,546 adults returning (CDFW 2018) showing the drought impact on juveniles from brood year 2013 (NMFS 2016c). Although impacts from hatchery fish (i.e., reduced fitness, weaker genetics, smaller size, less ability to avoid predators) are often cited as having deleterious impacts on natural in-river populations (Matala et al. 2012), the winter-run Chinook salmon conservation program at LSNFH is strictly controlled by the USFWS to reduce such impacts. The average annual hatchery production at LSNFH is approximately 176,348 per year (2001 to 2010 average) compared to the estimated natural production that passes RBDD, which is 4.7 million per year based on the 2002 to 2010 average (Poytress and Carrillo 2011). Therefore, hatchery production typically represents approximately 3 to 4 percent of the total in-river juvenile winter-run production in any given year. However, the average over the last 12 years (about four generations) is 13 percent, with the most recent generation at 20 percent hatchery influence, making the population at a moderate risk of extinction.

The distribution of winter-run spawning and initial rearing historically was limited to the upper Sacramento River (upstream of Shasta Dam), McCloud River, Pitt River, and Battle Creek, where springs provided cold water throughout the summer, allowing for spawning, egg incubation, and rearing during the mid-summer period (Yoshiyama et al. 1998). The construction of Shasta Dam in 1943 blocked access to all of these waters except Battle Creek, which currently has its own impediments to upstream migration (i.e., a number of small hydroelectric dams situated upstream of the Coleman National Fish Hatchery (CNFH) weir). The Battle Creek Salmon and Steelhead Restoration Project (BCSSRP) is currently removing these impediments, restoring spawning and rearing habitat suitable for winter-run Chinook salmon in Battle Creek, which will be reintroduced to establish an additional population. Approximately 299 miles of former tributary spawning habitat above Shasta Dam are inaccessible to winter-run Chinook salmon. Yoshiyama et al. (2001) estimated that in 1938, the upper Sacramento River had a "potential spawning capacity" of approximately 14,000 redds equal to 28,000 spawners. Since 2001, the majority of winter-run chinook salmon redds have occurred in the first 10 miles downstream of Keswick Dam. Most components of the winter-run Chinook salmon life history (e.g., spawning, incubation, freshwater rearing) have been compromised by the construction of Shasta Dam.

The greatest risk factor for winter-run Chinook salmon lies within its spatial structure (NMFS 2011a). The winter-run Chinook salmon ESU is comprised of only one population that spawns below Keswick Dam. The remnant and remaining population cannot access 95 percent of their historical spawning habitat and must therefore be artificially maintained in the upper Sacramento River by spawning gravel augmentation, hatchery supplementation, and regulation of the finite cold water pool behind Shasta Dam to reduce water temperatures.

Winter-run Chinook salmon require cold water temperatures in the summer that simulate their upper basin habitat, and they are more likely to be exposed to the impacts of drought in a lower basin environment. Battle Creek is currently the most feasible opportunity for the ESU to expand its spatial structure with early implementation of reintroduction efforts occurring in 2018. The NMFS Central Valley Salmon and Steelhead Recovery Plan includes criteria for recovering the winter-run Chinook salmon ESU, including re-establishing a population into historical habitats in Battle Creek as well as upstream of Shasta Dam (NMFS 2014).

Winter-run Chinook salmon embryonic and larval life stages that are most vulnerable to warmer water temperatures occur during the summer, which makes the species particularly at risk from climate warming. The only remaining population of winter-run Chinook salmon relies on the cold water pool in Shasta Reservoir, which buffers the effects of warm temperatures in most years. The exception occurs during drought years, which are predicted to occur more often with climate change (Yates et al. 2008). The long-term projection of how the CVP and SWP will operate incorporates the effects of climate change in three possible forms: less total precipitation; a shift to more precipitation in the form of rain rather than snow; or, earlier spring snow melt (U.S. Bureau of Reclamation 2008). Additionally, air temperature appears to be increasing at a greater rate than what was previously analyzed (Lindley 2008; Beechie et al. 2012; Dimacali 2013). These factors will compromise the quantity and/or quality of winter-run Chinook salmon habitat available downstream of Keswick Dam. It is imperative for additional populations of winter-run Chinook salmon to be re-established into historical habitat in Battle Creek and above Shasta Dam for long-term viability of the ESU (NMFS 2014).

Summary of the Sacramento River Winter-run Chinook Salmon Evolutionarily Significant Unit Viability

There are several criteria that would qualify the winter-run Chinook salmon population at moderate risk of extinction (continued low abundance, a negative growth rate over two complete generations, significant rate of decline since 2006, increased hatchery influence on the population, and increased risk of catastrophe), and because there is still only one population that spawns below Keswick Dam, the Sacramento River winter-run Chinook salmon ESU is at a high risk of extinction in the long term. The extinction risk for the winter-run Chinook salmon ESU has increased from moderate risk to high risk of extinction since 2005, and several listing factors have contributed to the recent decline, including drought, poor ocean conditions, and hatchery influence (NMFS 2016c). Thus, large-scale fish passage and habitat restoration actions are necessary for improving the winter-run Chinook salmon ESU viability (NMFS 2016d).

Critical Habitat and Physical or Biological Features for Sacramento River Winter-run Chinook Salmon

The critical habitat designation for Sacramento River winter-run Chinook salmon lists the PBFs (58 FR 33212, 33216-33217; June 16, 1993), which are described in NMFS (2016a). This designation includes the following waterways, bottom and water of the waterways, and adjacent riparian zones: the Sacramento River from Keswick Dam (river mile (RM) 302) to Chipps Island (RM 0) at the westward margin of the Delta; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge from San Pablo Bay to the Golden Gate Bridge (58 FR 33212; June 16, 1993). NMFS clarified that “adjacent riparian zones” are limited to only those areas above a stream bank that provide cover and shade to the nearshore aquatic areas (58 FR 33212, 33214; June 16, 1993). Although the bypasses (e.g., Yolo, Sutter, and Colusa) are not currently designated critical habitat for winter-run Chinook salmon, NMFS recognizes that they may be utilized when inundated with Sacramento River flood flows and are important rearing habitats for juvenile winter-run. Also, juvenile winter-run Chinook salmon may use tributaries of the Sacramento River for non-natal rearing (Maslin et al. 1997, PFMC and NMFS 2014).

Summary of Sacramento River Winter-run Chinook Salmon Critical Habitat

Currently, many of the PBFs of winter-run Chinook salmon critical habitat are degraded and provide limited high quality habitat. Factors that lessen the quality of migratory corridors for juveniles include unscreened diversions, altered flows in the Delta, and the lack of floodplain habitat. In addition, water operations that limit the extent of cold water below Shasta Dam have reduced the available spawning habitat (based on water temperature). Although the current conditions of winter-run Chinook salmon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.

2.2.2 Central Valley Spring-run Chinook Salmon

- Listed as threatened (64 FR 50394; September 16, 1999); reaffirmed (70 FR 37160; June 28, 2005).
- Designated critical habitat (70 FR 52488; September 2, 2005).

The federally listed ESU of CV spring-run Chinook salmon and designated critical habitat for this ESU occur in the action area and may be affected by the Program. Detailed information regarding ESU listing and critical habitat designation history, designated critical habitat, ESU life history, and VSP parameters can be found in the 5-Year Status Review of Central Valley Spring-run Chinook Salmon ESU (NMFS 2016b). Historically, CV spring-run Chinook salmon were the second most abundant salmon run in the Central Valley and one of the largest on the west coast (CDFG 1990). These fish occupied the upper and middle elevation reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1872, Rutter 1904, Clark 1929). The Central Valley drainage as a whole is estimated to have supported CV spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFG 1998). The San Joaquin River historically supported a large run of CV spring-run Chinook salmon, suggested to be one of the largest runs of any Chinook salmon on the West Coast, with estimates averaging 200,000 to 500,000 adults returning annually (CDFG 1990).

Monitoring of the Sacramento River mainstem during CV spring-run Chinook salmon spawning timing indicates some spawning occurs in the river (CDFW 2015). Genetic introgression has likely occurred here due to lack of physical separation between spring-run and fall-run Chinook salmon populations (CDFG 1998). Battle Creek and the upper Sacramento River represent persisting populations of CV spring-run Chinook salmon in the basalt and porous lava diversity group, though numbers remain low. Other Sacramento River tributary populations in Mill, Deer, and Butte creeks are likely the best trend indicators for the CV spring-run Chinook salmon ESU. Generally, these streams showed a positive escapement trend between 1991 and 2006, displaying broad fluctuations in adult abundance (NMFS 2016b). The Feather River Fish Hatchery (FRFH) CV spring-run Chinook salmon population represents an evolutionary legacy of populations that once spawned above Oroville Dam. The FRFH population is included in the ESU based on its genetic linkage to the natural spawning population and the potential for development of a conservation strategy (70 FR 37160; June 28, 2005).

The Central Valley Technical Review Team (TRT) estimated that historically there were 18 or 19 independent populations of CV spring-run Chinook salmon, along with a number of dependent populations, all within four distinct geographic regions (i.e., diversity groups) (Lindley et al. 2004). Of these populations, only three independent populations currently exist (Mill, Deer, and Butte creeks tributary to the upper Sacramento River), and they represent only the northern Sierra Nevada diversity group. Additionally, smaller populations are currently persisting in Antelope and Big Chico creeks and the Feather and Yuba Rivers in the northern Sierra Nevada diversity group (CDFG 1998). The northwestern California diversity group has two low-abundance persisting populations of spring-run Chinook salmon in Clear and Beegum creeks. In the San Joaquin River basin, the southern Sierra Nevada diversity group, observations in the last decade suggest that spring-running populations may currently occur in the Stanislaus and Tuolumne rivers (Franks 2014).

The CV spring-run Chinook salmon ESU is comprised of two known genetic complexes. Analysis of natural and hatchery spring-run Chinook salmon stocks in the Central Valley indicates that the northern Sierra Nevada diversity group spring-run Chinook salmon populations in Mill, Deer, and Butte creeks retain genetic integrity as opposed to the genetic integrity of the Feather River population, which has been somewhat compromised by introgression with the fall-run ESU (Good et al. 2005; Garza et al. 2008; Cavallo et al. 2011).

Because the populations in Butte, Deer, and Mill creeks are the best trend indicators for ESU viability, NMFS can evaluate risk of extinction based on VSP in these watersheds. Over the long term, these three remaining populations are considered to be vulnerable to anthropomorphic and naturally occurring catastrophic events. The viability assessment of CV spring-run Chinook salmon, conducted during NMFS' 2010 status review (NMFS 2011a), found that the biological status of the ESU had worsened since the last status review (2005), and the status review recommends that the species status be reassessed in 2 to 3 years as opposed to waiting another 5 years if the decreasing trend continued. In 2012 and 2013, most tributary populations increased in returning adults, averaging more than 13,000. However, 2014 returns were lower again—approximately 5,000 fish—indicating the ESU remains highly fluctuating. The most recent status review was conducted in 2015 (NMFS 2016b), and it looked at promising increasing populations in 2012 to 2014; however, the 2015 returning fish were extremely low (1,488), with additional pre-spawn mortality reaching record lows. Since the effects of the 2012 to 2015 drought have not been fully realized, NMFS anticipates at least several more years of very low returns, which may result in severe rates of decline (NMFS 2016b).

Spring-run Chinook salmon adults are vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson et al. 2011). CV spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and those tributaries without cold water refugia (usually input from springs) will be more susceptible to impacts of climate change. Even in tributaries with cool water springs, in years of extended drought and warming water temperatures, unsuitable conditions may occur. Additionally, juveniles often rear in the natal stream for one to two summers prior to emigrating, and they would be susceptible to warming water temperatures. In Butte Creek, fish are limited to low elevation habitat that is currently thermally marginal, as demonstrated by high summer mortality of adults in 2002, 2003, and 2015, and will become intolerable within decades if the climate warms as expected. Ceasing water diversion for power production from the summer holding reach in Butte Creek resulted in cooler water temperatures, more adults surviving to spawn, and extended population survival time (Mosser et al. 2013).

Summary of the Central Valley Spring-run Chinook Salmon Evolutionarily Significant Unit Viability

In summary, the extinction risk for the CV spring-run Chinook salmon ESU was evaluated for years 2012 – 2014, and the risk of extinction remained moderate (Williams et al. 2016). However, based on the severity of the drought and the low escapements, as well as increased prespawn mortality in Butte, Mill, and Deer creeks in 2015, there is concern that these CV spring-run Chinook salmon strongholds will deteriorate into high extinction risk in the coming years based on the population size or rate of decline criteria (NMFS 2016b).

Critical Habitat and Physical or Biological Features for Central Valley Spring-run Chinook Salmon

The critical habitat designation for CV spring-run Chinook salmon lists the PBFs (70 FR 52488; September 2, 2005), which are described in NMFS 2016b. In summary, the PBFs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine habitat. The geographic range of designated critical habitat includes stream reaches of the Sacramento, Feather, Yuba, and American rivers; Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks; and the Sacramento River as well as portions of the northern Delta (70 FR52488; September 2, 2005).

Summary of Central Valley Spring-run Chinook Salmon Critical Habitat

Currently, many of the PBFs of CV spring-run Chinook salmon critical habitat are degraded and provide limited high quality habitat. Factors that lessen the quality of migratory corridors for juveniles include unscreened or inadequately screened diversions, altered flows in the Delta, scarcity of complex in-river cover, and the lack of floodplain habitat. Although the current conditions of CV spring-run Chinook salmon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.

2.2.3 California Central Valley Steelhead

- Originally listed as threatened (63 FR 13347; March 19, 1998); reaffirmed (71 FR 834; January 5, 2006).
- Designated critical habitat (70 FR 52488; September 2, 2005).

The federally listed DPS of California Central Valley (CCV) steelhead and designated critical habitat for this DPS occur in the action area and may be affected by the Program. Detailed information regarding DPS listing and critical habitat designation history, designated critical habitat, DPS life history, and VSP parameters can be found in the 5-Year Status Review of California Central Valley Steelhead Distinct Population Segment (NMFS 2016a).

Historic CCV steelhead run sizes are difficult to estimate given the paucity of data, but may have approached one to two million adults annually (McEwan 2001). By the early 1960s, the CCV steelhead run size had declined to about 40,000 adults (McEwan 2001). Current abundance data for CCV steelhead are limited to returns to hatcheries and redd surveys conducted on a few rivers. The hatchery data are the most reliable because redd surveys for steelhead are often made difficult by high flows and turbid water usually present during the winter-spring spawning period.

CCV steelhead returns to CNFH increased from 2011 to 2014 (see NMFS 2016a for further information). After hitting a low of only 790 fish in 2010, 2013 and 2014 have averaged 2,895 fish. Wild adults counted at the hatchery each year represent a small fraction of overall returns, but their numbers have remained relatively steady, typically 200 to 300 fish each year. Numbers of wild adults returning each year ranged from 252 to 610 from 2010 to 2014, respectively.

Redd counts are conducted in the American River and in Clear Creek (Shasta County). An average of 143 redds have been counted on the American River from 2002 to 2015 (data from Hannon et al. 2003; Hannon and Deason 2008; Chase 2010). An average of 178 redds have been counted in Clear Creek from 2001 to 2015 following the removal of Saeltzer Dam, which allowed steelhead access to additional spawning habitat. The Clear Creek redd count data ranges from 100 to 1,023 and indicates an upward trend in abundance since 2006 (USFWS 2015a). The returns of CCV steelhead to the FRFH experienced a sharp decrease from 2003 to 2010, with only 679, 312, and 86 fish returning in 2008, 2009 and 2010, respectively. In recent years, however, returns have experienced an increase, with 830, 1,797, and 1,505 fish returning in 2012, 2013, and 2014, respectively. Overall, steelhead returns to hatcheries have fluctuated so much from 2001 to 2015 that no clear trend is present.

An estimated 100,000 to 300,000 naturally produced juvenile steelhead are estimated to leave the Central Valley annually, based on rough calculations from sporadic catches in trawl gear (Good et al. 2005). Nobriga and Cadrett (2001) used the ratio of adipose fin-clipped (hatchery) to unclipped (wild) steelhead smolt catch ratios in the USFWS Chipps Island trawl from 1998 through 2000 to estimate that about 400,000 to 700,000 steelhead smolts are produced naturally each year in the Central Valley. Trawl data indicate that the level of natural production of steelhead has remained very low since the 2011 status review, suggesting a decline in natural production based on consistent hatchery releases. Catches of steelhead at the fish collection facilities in the southern Delta are another source of information on the production of wild steelhead relative to hatchery steelhead (CDFW). The overall catch of steelhead has declined dramatically since the early 2000s, with an overall average of 2,705 in the last 10 years. The percentage of wild (unclipped) fish in salvage has fluctuated, but has leveled off to an average of 36 percent since a high of 93 percent in 1999.

About 80 percent of the historical spawning and rearing habitat once used by CCV steelhead in the Central Valley is now upstream of impassible dams (Lindley et al. 2006). Many historical populations of CCV steelhead are entirely above impassable barriers and may persist as resident or adfluvial rainbow trout, although they are presently not considered part of the DPS. Steelhead are well-distributed throughout the Central Valley below the major rim dams (Good et al. 2005, NMFS 2016a). Most of the steelhead populations in the Central Valley have a high hatchery component, including Battle Creek (adults intercepted at the CNFH weir), the American River, Feather River, and Mokelumne River.

The CCV steelhead abundance and growth rates continue to decline, largely the result of a significant reduction in the amount and diversity of habitats available to these populations (Lindley et al. 2006). Recent reductions in population size are supported by genetic analysis (Nielsen et al. 2003). Garza and Pearse (2008) analyzed the genetic relationships among CCV steelhead populations and found that unlike the situation in coastal California watersheds, fish below barriers in the Central Valley were often more closely related to below barrier fish from other watersheds than to *O. mykiss* above barriers in the same watershed. This pattern suggests the ancestral genetic structure is still relatively intact above barriers, but may have been altered below barriers by stock transfers. The genetic diversity of CCV steelhead is also compromised by hatchery origin fish, placing the natural population at a high risk of extinction (Lindley et al. 2007). Steelhead in the Central Valley historically consisted of both summer-run and winter-run Chinook salmon migratory forms. Only winter-run (ocean maturing) steelhead currently are found in California Central Valley rivers and streams as summer-run have been extirpated (McEwan and Jackson 1996; Moyle 2002).

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

Summary of California Central Valley Steelhead Distinct Population Segment Viability

All indications are that natural CCV steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good et al. 2005; NMFS 2016a); the long-term trend remains negative. Hatchery production and returns are dominant. Most wild CCV populations are very small and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to wild fish.

In summary, the status of the CCV steelhead DPS appears to have remained unchanged since the 2011 status review, and the DPS is likely to become endangered within the near future throughout all or a significant portion of its range (NMFS 2016a).

Critical Habitat and Physical or Biological Features for California Central Valley Steelhead

The critical habitat designation for CCV steelhead lists the PBFs (70 FR 52488; September 2, 2005), which are described in NMFS (2016a). In summary, the PBFs include freshwater spawning sites; freshwater rearing sites; freshwater migration corridors; and estuarine areas. The geographic extent of designated critical habitat includes the following: The Sacramento, Feather, and Yuba rivers and the Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries but excluding the mainstem San Joaquin River above the Merced River confluence; and the waterways of the Delta.

Summary of California Central Valley Steelhead Critical Habitat

Many of the PBFs of CCV steelhead critical habitat are degraded and provide limited high quality habitat. Passage to historical spawning and juvenile rearing habitat has been largely reduced due to construction of dams throughout the Central Valley. Levee construction has also degraded the freshwater rearing and migration habitat and estuarine areas as riparian vegetation has been removed, reducing habitat complexity and food resources and resulting in many other ecological effects. Contaminant loading and poor water quality in central California waterways pose threats to lotic fish, their habitat, and food resources. Additionally, due to reduced access to historical habitats, genetic introgression is occurring because naturally produced fish are interacting with hatchery-produced fish, which has the potential to reduce the long-term fitness and survival of this species.

Although the current conditions of CCV steelhead critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in the Sacramento-San Joaquin River watersheds and the Delta are considered to have high intrinsic value for the conservation of the species as they are critical to ongoing recovery efforts.

2.2.4 Southern Distinct Population Segment of North American Green Sturgeon

- Listed as threatened (71 FR 17757; April 7, 2006).
- Designated critical habitat (74 FR 52300; October 9, 2009).

The federally listed sDPS of North American green sturgeon and designated critical habitat for this DPS occur in the action area and may be affected by the Program. Detailed information regarding DPS listing and critical habitat designation history, designated critical habitat, DPS life history, and VSP parameters can be found in the 5-year Status Review of the Southern Distinct Population Segment of the North American Green Sturgeon (NMFS 2015a).

Green sturgeon are known to range from Baja California to the Bering Sea along the North American continental shelf. During late summer and early fall, subadults and non-spawning adult green sturgeon can frequently be found aggregating in estuaries along the Pacific coast (Emmett et al. 1991; Moser and Lindley 2006). Using polyploid microsatellite data, Israel et al. (2009b) found that green sturgeon within the Central Valley of California belong to the sDPS. Additionally, acoustic tagging studies have found that green sturgeon found spawning within the Sacramento River are exclusively sDPS green sturgeon (Lindley et al. 2011). In waters inland from the Golden Gate Bridge in California, sDPS green sturgeon are known to range through the estuary and the Delta and up the Sacramento, Feather, and Yuba rivers (Israel et al. 2009a, Seesholtz et al. 2015). It is unlikely that green sturgeon utilize areas of the San Joaquin River upriver of the Delta with regularity, and spawning events are thought to be limited to the upper Sacramento River and its tributaries. There is no known modern usage of the upper San Joaquin River by green sturgeon, and adult spawning has not been documented there (Jackson and Van Eenennaam 2012).

Recent research indicates that the sDPS is composed of a single, independent population, which principally spawns in the mainstem Sacramento River and also breeds opportunistically in the

Feather River and possibly the Yuba River (Seesholtz et al. 2014). Concentration of adults into a very few select spawning locations makes the species highly vulnerable to poaching and catastrophic events. The apparent, but unconfirmed, extirpation of spawning populations from the San Joaquin River narrows the available habitat within their range, offering fewer habitat alternatives. Whether sDPS green sturgeon display diverse phenotypic traits, such as ocean behavior, age at maturity, and fecundity, or if there is sufficient diversity to buffer against long-term extinction risk is not well understood. It is likely that the diversity of sDPS green sturgeon is low, given recent abundance estimates (NMFS 2015b).

Trends in abundance of sDPS green sturgeon have been estimated from two long-term data sources: (1) salvage numbers at the state and Federal pumping facilities (CDFW), and (2) by incidental catch of green sturgeon by the CDFW's white sturgeon sampling/tagging program (Dubois et al. 2011). Historical estimates from these sources are likely unreliable because the sDPS was likely not taken into account in incidental catch data, and salvage does not capture rangewide abundance in all water year types. A decrease in sDPS green sturgeon abundance has been inferred from the amount of take observed at the south Delta pumping facilities, the Skinner Delta Fish Protection Facility (SDFPF), and the Tracy Fish Collection Facility (TFCF). This data should be interpreted with some caution. Operations and practices at the facilities have changed over the project lifetime, which may affect salvage data. These data likely indicate a high production year versus a low production year qualitatively, but cannot be used to rigorously quantify abundance.

Since 2010, more robust estimates of sDPS green sturgeon have been generated. Researchers at the University of California, Davis used acoustic telemetry to locate green sturgeon in the Sacramento River and to derive an adult spawner abundance estimate (Mora et al. 2015). Preliminary results of these surveys estimate an average annual spawning run of 223 (using dual-frequency identification sonar (DIDSON)) and 236 (using telemetry) fish. This estimate does not include the number of spawning adults in the lower Feather or Yuba rivers, where green sturgeon spawning was recently confirmed (Seesholtz et al. 2015).

The parameters of green sturgeon population growth rate and carrying capacity in the Sacramento Basin are poorly understood. Larval count data shows enormous variance among sampling years. In general, sDPS green sturgeon year class strength appears to be highly variable with overall abundance dependent upon a few successful spawning events (NMFS 2010a). Other indicators of productivity such as data for cohort replacement ratios and spawner abundance trends are not currently available for sDPS green sturgeon.

The sDPS green sturgeon spawn primarily in the Sacramento River in the spring and summer. The Anderson-Cottonwood Irrigation District Diversion Dam (ACID) is considered the upriver extent of green sturgeon passage in the Sacramento River (71 FR 17757; April 7, 2006). The upriver extent of green sturgeon spawning, however, is approximately 30 kilometers downriver of ACID where water temperature is higher than ACID during late spring and summer (NMFS 2018). Thus, if water temperatures increase with climate change, temperatures adjacent to ACID may remain within tolerable levels for the embryonic and larval life stages of green sturgeon, but temperatures at spawning locations lower in the river may be more affected. It is uncertain, however, if green sturgeon spawning habitat exists closer to ACID, which could allow spawning to shift upstream in response to climate change effects. Successful spawning of green sturgeon in other accessible habitats in the Central Valley (i.e., the Feather River) is limited, in part, by late spring and summer water temperatures (NMFS 2015a). Similar to salmonids in the Central Valley, green sturgeon spawning in tributaries to the Sacramento River is likely to be further limited if water temperatures increase and higher elevation habitats remain inaccessible.

Summary of Green Sturgeon Southern Distinct Population Segment Viability

The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The risk of extinction is believed to be moderate (NMFS 2010a). Although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the viability of population abundance indices (NMFS 2010b). Lindley et al. (2008), in discussing winter-run Chinook salmon, states that an ESU (or DPS) represented by a single population at moderate risk of extinction is at high risk of extinction over a large timescale; this would apply to the sDPS for green sturgeon. The most recent 5-year status review for sDPS green sturgeon found that some threats to the species have recently been eliminated, such as take from commercial fisheries and removal of some passage barriers (NMFS 2015a). However, since many of the threats cited in the original listing still exist, the threatened status of the DPS is still applicable (NMFS 2015a).

Critical Habitat and Physical or Biological Features for Southern Distinct Population Segment Green Sturgeon

The critical habitat designation for sDPS green sturgeon lists the PBFs (74 FR 52300; October 9, 2009), which are described in NMFS 2015b. In summary, the PBFs include the following for both freshwater riverine systems and estuarine habitats: food resources, water flow, water quality, migratory corridor, depth, and sediment quality. Additionally, substrate type or size is also a PBF for freshwater riverine systems. In addition, the PBFs include migratory corridor, water quality, and food resources in nearshore coastal marine areas. The geographic range of designated critical habitat includes the following:

- In freshwater, the geographic range includes:

  - The Sacramento River from the Sacramento I Street bridge to Keswick Dam, including the Sutter and Yolo bypasses and the lower American River from the confluence with the mainstem Sacramento River upstream to the highway 160 bridge. - The Feather River from its confluence with the Sacramento River upstream to Fish Barrier Dam.

  - The Yuba River from its confluence with the Feather River upstream to Daguerre Point Dam.

  - The Delta (as defined by California Water Code Section 12220, except for listed excluded areas).

- In coastal bays and estuaries, the geographic range includes:

- San Francisco, San Pablo, Suisun, and Humboldt bays in California.

- Coos, Winchester, Yaquina, and Nehalem bays in Oregon.

- Willapa Bay and Grays Harbor in Washington.

- the lower Columbia River estuary from the mouth to river kilometer (RK) 74.

In coastal marine waters, the geographic range includes all United States coastal marine waters out to the 60-fathom-depth bathymetry line from Monterey Bay north and east to include waters in the Strait of Juan de Fuca, Washington.

Summary of Southern Distinct Population Segment Green Sturgeon Critical Habitat

Currently, many of the PBFs of sDPS green sturgeon are degraded and provide limited high-quality habitat. Factors that lessen the quality of migratory corridors for juveniles include unscreened or inadequately screened diversions, altered flows in the Delta, and presence of contaminants in sediment. Although the current conditions of green sturgeon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in both the Sacramento-San Joaquin River watersheds, the Delta, and nearshore coastal areas are considered to have high intrinsic value for the conservation of the species.

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). Not knowing the location, timing and size of projects covered by the Program, it is difficult to determine the extent of all areas affected directly or indirectly. Instead the action area is determined by the Program and it includes all stream channels, riparian areas, and hydrologically linked upslope areas that will be affected by the implementation of restoration projects included in the Program.

Restoration projects, that otherwise qualify and that occur within the area of NMFS CCVO jurisdiction could potentially occur within any stream occupied by the ESUs and DPSs located in the California Central Valley (Figure 1). The action area includes, either in whole or in part, the following hydrologic unit code (HUC) 8 sub-basins, as defined by United States Geological Survey (USGS): Cottonwood Headwaters, Honcut Headwaters, Lower American, Lower Bear, Lower Butte, Lower Calaveras – Mormon Slough, Lower Cosumnes – Lower Mokelumne, Lower Cottonwood, Lower Feather, Lower Sacramento, Lower Yuba, Middle San Joaquin – Lower Chowchilla, Middle San Joaquin – Lower Merced – Lower Stanislaus, Mill – Big Chico, North Fork Feather, Panoche – San Luis Reservoir, Sacramento – Lower Cow – Lower Clear, Sacramento – Lower Thomes, Sacramento – Stone Corral, Sacramento – Upper Clear, San Joaquin Delta, Upper Bear, Upper Butte, Upper Calaveras, Upper Chowchilla – Upper Fresno, Upper Coon – Upper Auburn, Upper Cosumnes, Upper Cow-Battle, Upper Elder – Upper Thomes, Upper Merced, Upper Mokelumne, Upper San Joaquin, Upper Stanislaus, and Upper Tuolumne.

2.4 Environmental Baseline

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

The proposed action area encompasses the entire freshwater range of the listed fish species and their proposed or designated critical habitat in this consultation. Section 2.2, *Rangewide Status of the Species and Critical Habitat* provides general information on the fish species' biology, status, and factors affecting abundance at the species scale. General discussion of the environmental baseline for fish species follows in this section.

Because this programmatic consultation covers specific projects, which are yet to be determined, the current condition of fish or critical habitats at potential project sites and the conservation role those specific areas may play cannot be defined at this time. Therefore, to complete the effects analyses, jeopardy analyses and destruction or adverse modification of critical habitat analyses in this consultation, we made the following assumptions regarding the environmental baseline in each area that will eventually be identified to support an action: (1) The purpose of the proposed action is to facilitate restoration projects for the benefit of listed aquatic species; (2) each individual project's action area will be occupied by or be critical habitat for one or more listed species; (3) the biological requirements of individual fish in those areas are not currently being fully met because aquatic habitat functions, including functions related to habitat factors limiting the recovery of the species in each area, are impaired; and (4) active restoration at each site is likely to improve the factors limiting recovery of federally listed fish in that area.

2.4.1 Status of the Species in the Action Area

This section is organized by species and cross referenced with the four management units described in Section 1.3.4 *Programmatic Sideboards and Other Program Requirements*.

Sacramento River Winter-run Chinook Salmon

Status of Sacramento River Winter-run Chinook in the Action Area

The action area encompasses the entire critical habitat designation for winter-run Chinook salmon and includes almost all habitats used throughout the life cycle of this species. Assessing the temporal occurrence of each life stage of winter-run Chinook in the action area is done through monitoring data in the Sacramento River and Delta as well as salvage data from the Tracy and Skinner fish collection facilities in the south Delta (CVP and SWP) (Table 2-1).

Table 2-1. The Temporal Occurrence of Adult (a) and Juvenile (b) Winter-run Chinook Salmon in the Sacramento River.

Relative Abundance					Medium				Low			
a) Adults freshwater												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento River basin[a,b]												
Upper Sacramento River spawning[c]												
Delta												
b) Juvenile emigration												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento River at Red Bluff[d]												
Sacramento River at Knights Landing[e]												
Sacramento trawl at Sherwood Harbor[f]												
Midwater trawl at Chipps Island[g]												

Sources: a: Yoshiyama et al. (1998); Moyle (2002); b: Myers et al. (1998); c: Williams (2006); d: Martin et al. (2001); e: Knights Landing Rotary Screw Trap Data, CDFW (1999-2011); f,g: Delta Juvenile Fish Monitoring Program, USFWS (1995-2012)

Adult winter-run Chinook salmon begin their upstream migration through the Sacramento/San Joaquin Delta (MU3) in December and continue through July with a peak occurring between the months of December and April (NMFS 2014). Adult winter-run Chinook salmon return from the ocean prior to reaching full sexual maturity and hold in the Sacramento River for several months before spawning while they mature. Currently, the spawning range of winter-run Chinook salmon is confined to the Sacramento River between Red Bluff Diversion Dam (RBDD) (RM 243) and Keswick Dam (RM 302) (Vogel and Marine 1991; NMFS 2014). Historically, spawning likely occurred upstream of Shasta Dam in spawning reaches which are no longer accessible to anadromous fish (Yoshiyama et al. 1998), as well as in an upper tributary to the Sacramento River, Battle Creek (Lindley et al. 2004).

The upper Sacramento River below Keswick Dam portion of the action area, described by MU1, is critically important for the survival and recovery of this species as it contains the only known remaining spawning grounds. As winter-run spawning occurs in the summer months, naturally-occurring summer flows in river reaches below Keswick Dam, where this species currently spawns, would have precluded spawning historically. This suggests that the area below Shasta and Keswick dams was likely utilized for winter-run juvenile rearing and migration only. Currently, flows in the Sacramento River are artificially managed at both Keswick and Shasta dams in order to provide appropriate spawning and egg incubation temperatures and flows through winter-run Chinook salmon spawning grounds (Boles 1988, Yates et al. 2008, NMFS 2014). There is an ongoing effort to restore 42 miles of salmon habitat on Battle Creek in MU4 as part of the Battle Creek Salmon and Steelhead Restoration Project (Bottom et al. 2005), leading to Pacific Gas and Electric's application to the Federal Energy Regulatory Commission to modify operations of hydropower projects on North Fork and South Fork Battle Creek (NMFS 2009b). These improved flows and re-opening of spawning and rearing habitat is expected to benefit winter-run Chinook salmon when reintroduced to the stream, and to aid in the recovery of this species.

There are uncertainties about Reclamation's ability to maintain an adequate cold water pool in Shasta Reservoir in order to maintain suitable temperatures for winter-run Chinook salmon egg incubation, fry emergence, and juvenile rearing in the Sacramento River in critically dry years and extended drought periods. Through NMFS' 2009 biological opinion on the long-term water operations of the CVP/SWP (NMFS 2009a), Reclamation has created and implemented Shasta Reservoir storage plans and year-round Keswick Dam release schedules and procedures with the goal of providing cold water for spawning and rearing (NMFS 2016c).

However, warm-water releases from Shasta Dam have been a significant stressor to winter-run Chinook salmon, especially given the recent extended drought in California from 2012 through 2015 (NMFS 2016c). Warm water releases from Shasta Reservoir in 2014 and 2015 contributed to 5.9 percent and 4.2 percent egg-to-fry survival rates respectively, to RBDD. Under varying hydrologic conditions from 2002 to 2013, winter-run Chinook salmon egg-to-fry survival ranged from three to nearly 10 times higher than in 2014 and 2015. Measures taken as part of a coordinated drought response (Swart 2016) to reduce this threat and improve Shasta Reservoir cold water pool management have been to: (1) relax Wilkins Slough navigational flow requirements; (2) relax D-1641 Delta water quality requirements; (3) delay Sacramento River Settlement Contractor depletions, and transfer a volume of their water in the fall rather than increase depletions throughout the summer; (4) target slightly warmer temperatures during the winter-run Chinook salmon holding period (before spawning occurs); (5) replace the Spring Creek and Oak Bottom temperature control curtains in Whiskeytown Reservoir; and (6) install the Shasta Dam temperature control device curtain in 2015 (NMFS 2016c). Other efforts to reduce the likelihood of warm water releases from Shasta Dam include improving reservoir, meteorologic, and hydrologic modeling and monitoring in order to most efficiently and effectively manage the reservoir's limited amount of cold water, installation of additional temperature monitoring stations in the upper Sacramento River to better monitor real-time water temperatures, and enhanced redd, egg, and juvenile winter-run Chinook salmon monitoring (NMFS 2016c).

The Livingston Stone National Fish Hatchery began operation in 1997 and functions to supplement the naturally occurring population of Sacramento River winter-run Chinook salmon in order to aid in its survival and recovery (California Hatchery Scientific Review Group (California HSRG) 2012). The facility is intended to be a temporary conservation measure and will cease operations once the population of winter-run Chinook salmon is considered to be viable and fully recovered. Winter-run that are produced at LSNFH are intended to return to the upper Sacramento River as adults and become reproductively and genetically assimilated into the natural population (California HSRG 2012). In order to improve hatchery management, the USFWS has developed and implemented a secondary fish trapping location for the LSNFH winter-run Chinook salmon supplementation program at the Anderson-Colusa Irrigation District dam to provide increased opportunity to capture a spatially representative sample and target numbers of broodstock (USFWS 2015b). This hatchery program is expected to play a continuing role as a conservation hatchery to help recover winter-run Chinook salmon. The LSNFH captive broodstock and supplementation Hatchery and Genetic Management Plans are complete and currently undergoing section 7 consultation with NMFS.

Juvenile winter-run Chinook salmon use the Sacramento River in MU2 and MU3 for rearing and migration and small numbers have also been shown to utilize the lower American River for rearing (Reclamation 2015). Juveniles migrate downstream through the Sacramento River in late fall/early winter. Until 1978 when the State Water Resources Control Board instituted closures of the Delta Cross Channel (DCC) to protect migratory fish, the DCC posed a threat of entrainment into the interior Delta for outmigrating juvenile winter-run Chinook salmon. Following the institution of additional operational criteria for the DCC, it now remains closed from February 1st through May 20th, protecting outmigrating juvenile winter-run Chinook salmon and preventing entrainment into the interior Delta (NMFS 2009a).

Juvenile winter-run Chinook salmon begin to enter the Delta in October and outmigration continues until April. Juvenile outmigration timing is thought to be strongly correlated with winter rain events that result in higher flows in the Sacramento River (del Rosario et al. 2013). Winter-run Chinook salmon use the Delta primarily as a migration corridor as they make their way to Suisun and San Pablo Bays and eventually the Pacific Ocean. Relative abundance in the Delta is inferred through salvage monitoring data, CDFW rotary screw trap sampling, and USFWS Delta Juvenile Fish Monitoring Program (DJFMP) data. Juvenile mortality in the Delta and San Francisco estuary continues to be investigated. A conclusive primary source has yet to be identified, though Delta outflow seems to play an important role (Baker and Morhardt 2001). Predation by piscivorous fish has been at the forefront of this debate and multiple studies have attempted to address the scale at which this source of mortality is affecting the population as a whole (Lindley and Mohr 2003; Demetras et al. 2016).

Status of Sacramento River Winter-run Chinook Critical Habitat in the Action Area

The proposed action area encompasses the entirety of the rangewide riverine and estuarine critical habitat PBFs for winter-run. Wide-spread degradation to these PBFs has had a major contribution to the status of the winter-run ESU, which is at high risk of extinction (NMFS 2016c). PBFs (as discussed in the Section 2.2 *Rangewide Status of the Species*) include: (1) access from the Pacific Ocean to appropriate spawning areas in the upper Sacramento River, (2) the availability of clean gravel for spawning substrate, (3) adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles, (4) water temperatures between 42.5 and 57.5°F (5.8 and 14.1°C) for successful spawning, egg incubation, and fry development, (5) habitat and adequate prey that are not contaminated, (6) riparian habitat that provides for successful juvenile development and survival, and (7) access downstream so that juveniles can migrate from the spawning grounds to San Francisco Bay and the Pacific Ocean.

Passage impediments in the northern region of the Central Valley are largely responsible for isolating the existing population from historical spawning reaches, which occurred upstream of Keswick and Shasta dams and included the upper Sacramento River, McCloud River, Pit River, Fall River and Hat Creek (Yoshiyama et al. 1996; Lindley et al. 2004; NMFS 2014). Due to the installation of Keswick and Shasta dams, the winter-run ESU is now relegated to spawning downstream, in the Sacramento River. The majority of spawning occurs between Red Bluff (Red

Bluff Diversion Dam) and Redding (below Keswick Dam) (Vogel and Marine 1991; NMFS 2014). PBFs #2-4 for this ESU have been degraded in a number of ways. Spatially, the total area of viable spawning habitat has been significantly diminished. Physical features that are essential to the functionality of existing spawning habitat have also been degraded, including loss of spawning gravel and elevated water temperatures during summer months when spawning events occur (NMFS 2014). Degradation of these features is actively mitigated through real-time temperature and flow management at Shasta and Keswick dams (NMFS 2009a) as well as gravel augmentation projects in the affected area, which have been occurring under a multi-year programmatic authority (NMFS 2016d).

PBFs related to the rearing and migration of juveniles and adults have been degraded from their historical condition within the action area as well. Adult passage impediments on the Sacramento River existed for many years at the RBDD and ACID diversion dam (NMFS 2014). However, the RBDD was decommissioned in 2013 providing unimpaired juvenile and adult fish passage and a fish passage improvement project at the ACID dam was completed in 2015, so that adult winter-run Chinook salmon could migrate through the structure at a broader range of flows reaching spawning habitat upstream of that structure.

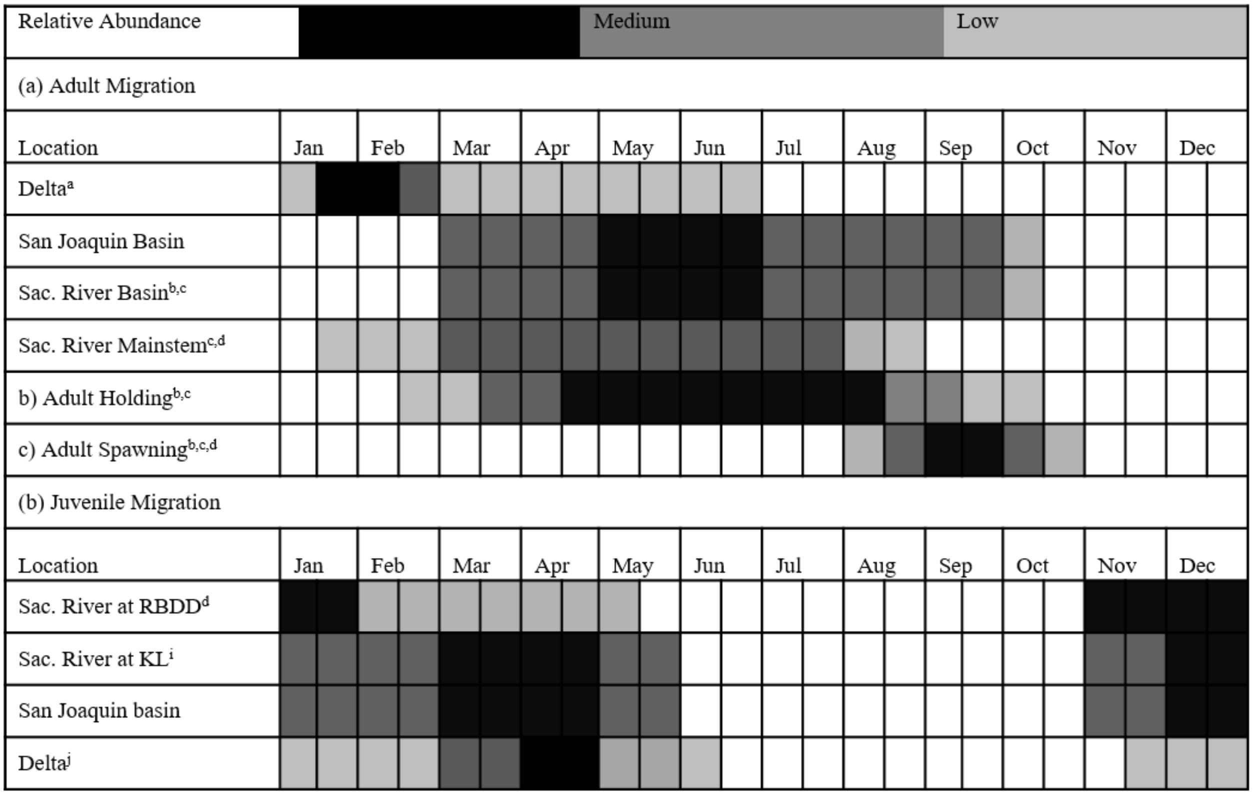
Juvenile migration corridors are impacted by reverse flows in the Delta that become exacerbated by water export operations at the CVP/SWP pumping plants. This is thought to result in impaired routing and timing for outmigrating juveniles and is evidenced by the presence of juvenile winter-run at the state and Federal fish salvage facilities. Shoreline armoring and development has reduced the quality and quantity of floodplain habitat for rearing juveniles in the Delta and Sacramento River (Williams et al. 2009; Boughton and Pike 2013). Juveniles have access to floodplain habitat in the Yolo Bypass only during mid to high water years, and the quantity of floodplain available for rearing during drought years is currently limited. The Yolo Bypass Restoration Plan includes notching the Fremont Weir, which will provide access to floodplain habitat for juvenile salmon over a longer period (Department of Water Resources and U.S. Bureau of Reclamation 2012).

Central Valley Spring-run Chinook Salmon and California Central Valley Steelhead

Status of Central Valley Spring-run Chinook in the Action Area

The Sacramento River, American River and Sacramento/San Joaquin Delta are included in the action area and aside from the American River (which only currently supports non-natal rearing of juveniles), are extensively used by various life stages of the Central Valley spring-run Chinook salmon ESU. Assessing the temporal occurrence of each life stage of spring-run Chinook salmon in the action area is done through analysis of monitoring data in the Sacramento River and select tributaries; monitoring in the Delta; and salvage data from the Tracy and Skinner fish collection facilities in the south Delta (CVP and SWP) (Table 2-2).

Table 2-2. The Temporal Occurrence of Adult (a) and Juvenile (b) Central Valley Spring-run Chinook Salmon in the Mainstem Sacramento River.



Sources: a: CDFG (1998); b: Yoshiyama et al. (1998); c: Moyle (2002); d: Myers et al. (1998); e: Lindley et al. (2004); f: CDFG (1998); g: McReynolds et al. (2007); h: Ward et al. (2003); i: Snider and Titus (2000); j: SacTrawl (2015). Note: Yearling spring-run Chinook salmon rear in their natal streams through the first summer following their birth. Downstream emigration generally occurs the following fall and winter. Most young-of-the-year spring-run Chinook salmon emigrate during the first spring after they hatch.

Adult spring-run Chinook salmon enter the San Francisco estuary to begin their upstream spawning migration through MU3 in late January and early February (CDFG 1998). They enter the Sacramento River between March and September, primarily in May and June (Yoshiyama et al. 1998; Moyle 2002). Generally, adult spring-run Chinook salmon are sexually immature when they enter freshwater habitat and must hold in deep pools for up to several months in preparation for spawning (Moyle 2002). The Delta and Sacramento River in MU3, MU2 and MU1 provide a critical migration corridor for spawning adults, allowing them access to spawning grounds upstream.

Monitoring of the Sacramento River mainstem during spring-run Chinook salmon spawning timing indicates that some spawning occurs in the river. Although physical habitat conditions in the accessible upper Sacramento River can support spring-run Chinook salmon spawning and incubation, significant hybridization/introgression with fall-run Chinook salmon due to lack of spatial/temporal separation makes identification of spring-run Chinook salmon in the mainstem very difficult (CDFG 1998). Counts of Chinook salmon redds in MU1 are typically used as an indicator of the Sacramento River spring-run Chinook salmon population abundance. Fewer than fifteen Chinook salmon redds per year were observed in the Sacramento River from 1989 to 1993 based on September aerial redd counts. Redd surveys conducted in September between 2001 and 2011 have observed an average of 36 Chinook salmon redds from Keswick Dam downstream to the RBDD, ranging from 3 to 105 redds; from 2012 to 2015, close to zero redds were observed, except in 2013, when 57 redds were observed in September (CDFW 2015).

Currently, the majority of returning adult spring-run Chinook salmon spawn in the tributaries to the Sacramento River, and described by MU4. MU1 and MU2 of the Sacramento River mainly functions as both rearing habitat for juveniles and the primary migratory corridor for outmigrating juveniles and spawning adults for all the Sacramento River basin populations. The juvenile life stage of CV spring-run Chinook salmon exhibits varied rearing behavior and outmigration timing. Juveniles may reside in the action area for 12–16 months (these individuals are characterized as "yearlings"), while some may migrate to the ocean as young-of-the-year (NMFS 2014).

The Delta is utilized by juveniles prior to entering the ocean. Within the Delta (MU3), juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels, and sloughs (McDonald 1960; Dunford 1975). Juvenile spring-run Chinook salmon use Suisun Marsh extensively as a migratory pathway, though they likely move through quickly based on their size upon entering the bay (as compared to fall-run, which enter this area at a smaller size and likely exhibit rearing behavior prior to continuing their outward migration) (Brandes and McLain 2001; Williams 2012).

An experimental population of spring-run Chinook salmon has been designated under section 10(j) of the ESA in the San Joaquin River from Friant Dam downstream to its confluence with the Merced River (78 FR 79622; December 31, 2013), and spring-run Chinook salmon are currently being reintroduced to the San Joaquin River. The experimental population area in the San Joaquin River is described by MU3 and MU4. A conservation stock of spring-run Chinook is being developed at the San Joaquin River Conservation and Research Facility at Friant Dam and individuals have been released annually since 2014 to the lower San Joaquin River (CDFW 2014). In 2016, the San Joaquin River Restoration Program released 57,320 Feather River Fish Hatchery and 47,560 San Joaquin River Conservation and Research Facility spring-run Chinook salmon juveniles to the San Joaquin River just upstream of the confluence with the Merced River (San Joaquin River Restoration Program 2018).

In addition, observations in the last decade suggest that spring-running populations may currently occur in the Stanislaus and Tuolumne rivers (Franks 2014), tributary rivers to the mainstem San Joaquin River and included in MU3. Although the exact number of spring-running Chinook salmon in the San Joaquin basin is unknown, juvenile and adult spring-run use the portion of the lower San Joaquin River within the Delta as a migratory pathway.

Spring-run Chinook salmon adults are vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson et al. 2011). Spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and without cold water refugia (usually input from springs), those tributaries will be more susceptible to impacts of climate change. Even in tributaries with cool water springs, in years of extended drought and warming water temperatures, unsuitable conditions may occur. Additionally, juveniles often rear in their natal stream over the summer prior to emigrating (McReynolds et al. 2007) and would be susceptible to warming water temperatures.

The status of spring-run critical habitat in the action area is discussed below in the discussion of the status of steelhead critical habitat in the action area

Status of California Central Valley Steelhead in the Action Area

CCV steelhead exhibit a similar life history to CV spring-run Chinook and occupy a similar geographic range. As described above, CCV steelhead also extensively use the Sacramento River, and Sacramento/San Joaquin Delta described by MU3, MU2 and MU1, to reach the natal streams of MU4. Assessing the temporal occurrence of each life stage of CCV steelhead in the action area is done through analysis of monitoring data in the Sacramento River and select tributaries; monitoring in the Delta; and salvage data from the Tracy and Skinner fish collection facilities in the south Delta (CVP and SWP) (Table 2-3). The only portion of the action area to contain spawning habitat is the lower American River.

Table 2-3. The Temporal Occurrence of (a) Adult and (b) Juvenile California Central Valley Steelhead at Locations in the Action Area.

Relative Abundance						Medium					Low		
(a) Adult migration													
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Delta													
Sacramento R. at Fremont Weir[a]													
Sacramento R. at RBDD[b]													
San Joaquin River[c]													
(b) Juvenile migration													
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Sacramento R. near Fremont Weir[a,b]													
Sacramento R. at Knights Landing[d]													
Chipps Island (clipped)[e]													
Chipps Island (unclipped)[e]													
San Joaquin R. at Mossdale[f]													

Sources: a: Hallock (1957); b: McEwan (2001); c: CDFG Steelhead Report Card Data (2007); d: NMFS analysis of 1998-2011 CDFW data; e: NMFS analysis of 1998-2011 USFWS data; f: NMFS analysis of 2003-2011 USFWS data.

Spawning adults enter the San Francisco Bay estuary and Delta from August to November (with a peak in September (Hallock et al. 1961)). Spawning occurs in a number of tributaries to the Sacramento River, to which the Delta and Sacramento River serve as key migratory corridors (NMFS 2014). Spawning occurs from December to April, with a peak in January through March, in rivers and streams where cold, well-oxygenated water is available (Hallock et al. 1961; McEwan and Jackson 1996; Williams 2006). Adults typically spend a few months in freshwater before spawning (Williams 2006), but very little is known about where they hold between entering freshwater and spawning in rivers and streams. Use of the Delta (MU3) by adults is also poorly understood.

Juvenile CCV steelhead rear in cool, clear, fast-flowing streams and are known to prefer riffle habitat over slower-moving pools (NMFS 2014; Reclamation 2015). The Sacramento River and Delta are likely used primarily as migratory corridors. Little is known about the rearing behavior of juveniles in the Delta; however, they are thought to exhibit short periods of rearing and foraging in tidal and non-tidal marshes and other shallow areas prior to their final entry into the ocean.

The lower American River contains a naturally spawning population of CCV steelhead, which spawn downstream of Nimbus Dam. The dam is an impassable barrier to anadromous fish, isolating historical spawning habitat located in the North, Middle and South forks of the upper American River. In recent years, spawning adults have been observed with intact adipose fins indicating that a portion of the in-river population is of wild origin (Hannon 2013). Juvenile *O. mykiss* (anadromous and resident forms) have been observed to occupy fast-flowing riffle habitat in the lower American River, which is consistent with known life history traits of this species.

Nimbus hatchery, located on the lower American River adjacent to Nimbus Dam, produces the anadromous form of *O. mykiss*; however, steelhead from Nimbus hatchery are not included in the CCV steelhead DPS due to genetic integrity concerns from use of out-of-basin broodstock (71 FR 834; January 5, 2006). To specifically address this issue and in response to RPA Action II.6.1 contained in the NMFS (2009) biological opinion for long-term operations of the CVP/SWP, genetic testing of American River *O. mykiss* population was completed in 2014 to inform the planning for Nimbus Hatchery broodstock replacement that will support the CCV steelhead DPS (NMFS 2016a).

The portion of the lower San Joaquin River within the Delta (MU3) is used by migrating adult CCV steelhead heading upstream to reach spawning areas, and by juveniles migrating downstream to reach rearing grounds (FISHBIO LLC 2012b; FISHBIO LLC 2012c; CDFW 2018).

Although steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat, the effects may be even greater in some cases, as juvenile steelhead may rear in freshwater over the summer prior to emigrating as smolts (Snider and Titus 2000). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough et al. 2001). McCullough et al. (2001) recommended an optimal incubation temperature at or below 11°C to 13°C (52°F to 55°F), and successful smoltification in steelhead may be impaired by temperatures above 12°C (54°F) (Richter and Kolmes 2005). In some areas, stream temperatures that currently provide marginal habitat for spawning and rearing may become too warm to support naturally spawning steelhead populations in the future.

Status of Central Valley Spring-run Chinook Salmon and California Central Valley Steelhead Critical Habitat in the Action Area

The entirety of designated critical habitat for both CV spring-run Chinook salmon and CCV steelhead is contained within the proposed action area. PBFs for both species are concurrently defined in (70 FR 52488; September 2, 2005) and the following PBFs, in summary, for these species are present in the proposed action area: (1) freshwater spawning sites, (2) freshwater rearing sites, (3) freshwater migration corridors, and (4) estuarine areas.

Historically, both CV spring-run Chinook salmon and CCV steelhead spawned in many of the headwaters and upstream portions of the Sacramento River and San Joaquin River basins described by MU4 and portions of MU3. Similar to winter-run Chinook salmon, passage impediments have contributed to substantial reductions in the populations of these species by isolating them from much of their historical spawning habitat. Naturally spawning spring-run Chinook salmon had been extirpated from the San Joaquin River basin entirely; however, an experimental population has been reintroduced to the river under Section 10(j) of the ESA and spring-running adults have been documented migrating into the San Joaquin tributaries (Franks 2014). The PBF of freshwater spawning sites for these species has been degraded within the action area due to high water temperatures, redd dewatering, and loss of spawning gravel recruitment in reaches below Keswick Dam (Wright and Schoellhamer 2004; Good et al. 2005; NMFS 2009a; Jarrett 2014). These issues are actively addressed by adaptive flow management in both rivers as well as spawning gravel augmentation projects in both reaches (NMFS 2009a; 2015d; 2016e).

Freshwater rearing and migration PBFs have been degraded from their historical condition within the action area. In the Sacramento River and San Joaquin, riverbank armoring has significantly reduced the quantity of floodplain rearing habitat for juvenile salmonids and has altered the natural geomorphology of the river (NMFS 2014). Similar to winter-run Chinook salmon, CV spring-run and CCV steelhead are only able to access large floodplain areas such as the Yolo Bypass under certain hydrologic conditions which do not occur in drier years. However, the Yolo Bypass Restoration Plan includes notching the Fremont Weir, which will provide access to floodplain habitat for juvenile spring-run Chinook salmon and steelhead over a longer period (Department of Water Resources and U.S. Bureau of Reclamation 2012). Levee construction involves the removal of riparian vegetation, resulting in reduced habitat complexity and shading, making juveniles more susceptible to predation. Additionally, loss of riparian vegetation reduces aquatic macroinvertebrate recruitment resulting in decreased food availability for rearing juveniles (Anderson and Sedell 1979; Pusey and Arthington 2003).

The lower Feather and American Rivers have experienced similar losses of rearing habitat; however, projects sponsored by Reclamation are restoring rearing habitat for juvenile CCV steelhead through the creation of side channels and placement of instream woody material (Reclamation 2015).

Within the proposed action area, the estuarine area PBF includes the legal Delta, encompassing significant reaches of the Sacramento and San Joaquin rivers that are tidally influenced (70 FR 52488; September 5, 2005). Estuarine habitat in the Delta is significantly degraded from its historical condition due to levee construction, shoreline development, and dramatic alterations to the natural hydrology of the system due to water export operations (NMFS 2014). Though critical habitat for CV spring-run occurs in the north Delta and not the interior or south Delta, it is thought that some entrainment into the interior Delta may occur during DCC gate openings. However, the 2014 drought year prompted protections for CV spring-run at the DCC (NMFS 2016a). Reverse flows in the central and south Delta resulting from water exports may exacerbate interior Delta entrainment by confounding flow and temperature-related migratory cues in outmigrating juveniles. The presence of these stressors, which cause altered migration timing and routing, degrade critical habitat PBFs related to rearing and migration.

sDPS North American Green Sturgeon

Status of sDPS North American Green Sturgeon in the Action Area

The sDPS green sturgeon exhibit a more complex life history with respect to salmonids and less is known about the ecology and behavior of their various life stages in the action area. Some acoustic telemetry (Kelly et al. 2007; Heublein et al. 2009) and multi-frequency acoustic survey work (Mora et al. 2015) has been done to study adult migration patterns and habitat use in the action area (Delta and Sacramento River). Field surveys have also been conducted on the Sacramento River to study spatial and temporal occurrence of early life stages (Poytress et al. 2010; 2011; 2012; 2013; Poytress et al. 2015). These studies have documented some spatial patterns in spawning events on the upper reaches of the Sacramento River in MU1 and MU2. Although Seesholtz et al. (2015) observed spawning in the Feather River, no known spawning events have been observed in the lower American River or in the portion of the lower San Joaquin River that is included in the Delta (MU3). Additionally, several lab studies have been conducted using early life stages to investigate ontogenic responses to elevated thermal regimes as well as foraging behavior as a function of substrate type (Allen et al. 2006a; Allen et al. 2006b; Nguyen and Crocker 2006; Linares-Casenave et al. 2013). However, due to sparse monitoring data for juvenile, sub-adult and adult life stages in the Sacramento River and Delta, there are significant data gaps to describe the ecology of this species in the action area. It is understood that spawning occurs in the upper reaches of the Sacramento River and Feather River (Seesholtz et al. 2015; Poytress et al. 2015), so the mainstem Sacramento and Delta serve as rearing habitat and a migratory corridor for this species. Some rearing also may occur in the lowest reaches of the lower American River where deep pools occur for rearing of older lifestages (downstream of SR-160 bridge) (Thomas et al. 2013). Information gaps encountered in efforts to summarize information on sDPS green sturgeon life history are often addressed using known information about the nDPS.

Southern DPS green sturgeon spawn primarily in the Sacramento River in the spring and summer, with the farthest upstream spawning event in the Sacramento River documented near Ink's Creek at river km 426 in MU1 (Poytress et al. 2015a). However, Heublein (2009) detected adults as far upstream as river km 451 near Cow Creek, suggesting that their spawning range may extend farther upstream than previously documented. The upstream extent of their spawning range lies somewhere below ACID (RM 206), as that dam impedes passage for green sturgeon in the Sacramento River (Heublein et al. 2009). It is uncertain, however, if green sturgeon spawning habitat exists closer to ACID, which could allow spawning to shift upstream in response to climate change effects. Successful spawning of green sturgeon in other accessible habitats in the Central Valley (i.e., the Feather River) is limited, in part, by late spring and summer water temperatures. Similar to salmonids in the Central Valley, green sturgeon spawning in the major lower river tributaries to the Sacramento River are likely to be further limited if water temperatures increase over time. In a bioenergetics study, 15-19°C was the optimal thermal range for age-0 green sturgeon (Mayfield and Cech 2004). If temperatures in spawning habitat exceed that range in the future, it may reduce the fitness of early life stages.

Table 2-4 The Temporal Occurrence of (a) Spawning Adult, (b) Larval, (c) Young Juvenile, (d) Juvenile, and (e) Sub-adult and Non-spawning Adult Southern DPS Green Sturgeon at Locations in the Action Area. Darker shades indicate months of greatest relative abundance.

(a) Adult-sexually mature (≥145 cm TL females, ≥ 120 cm TL males), including pre- and post-spawning individuals.												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sac River (rkm 332.5-451)												
Sac River (< rkm 332.5)												
Sac-SJ-SF Estuary												
(b) Larval												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sac River (> rkm 332.5)												
(c) Juvenile (≤5 months old)												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sac River (> rkm 332.5)												
(d) Juvenile (≥5 months)												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sac River (< rkm 391)												
Sac-SJ Delta, Suisun Bay												
(e) Sub-Adults and Non-spawning adults												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SAC-SJ-SF Estuary												
Pacific Coast												
Coastal Bays & Estuaries												
Relative Abundance:		= High				= Medium				= Low		

Status of sDPS North American Green Sturgeon Critical Habitat in the Action Area

Critical habitat for sDPS green sturgeon is contained within all of the proposed action area. All PBFs for sDPS green sturgeon critical habitat are present in the action area, except PBFs for nearshore coastal marine areas. The PBFs in the action area include, in summary: (1) food resources; (2) substrate type or size; (3) water flow; (4) water quality; (5) migratory corridor; (6) depth; and (7) sediment quality. These PBFs apply to both riverine and estuarine areas except "substrate type or size," which pertains to spawning habitats and only applies to riverine areas. These PBFs are described in detail in the rangewide status of sDPS green sturgeon in Section 2.2.

The historical spawning range of sDPS green sturgeon is not well known, though they are thought to have spawned in many of the major tributaries of the Sacramento River basin, many of which are isolated due to passage impediments (Beamesderfer et al. 2004). Green sturgeon use the lower Sacramento River for spawning and are known to spawn in its upper reaches between RBDD and Keswick Dam (Poytress et al. 2015a). Similar to the listed salmonid species addressed in this opinion, PBFs related to spawning and egg incubation have been degraded. Changes in flow regimes and the installation of Keswick and Shasta dams have significantly reduced the recruitment of spawning gravel in the upper reaches of the lower Sacramento River. Flow conditions in the Sacramento River have also been significantly altered from their historical condition. The degree to which these altered flow regimes affects outmigration dynamics of juveniles is unknown; however, some suitable habitat exists and spawning events have been consistently observed annually (Poytress et al. 2015a).

PBFs for sDPS green sturgeon in the lower reaches of the Sacramento River and the Delta have also been significantly altered from their historical condition. However, green sturgeon exhibit very different life history characteristics from those of salmonids and therefore use habitat within the proposed action area differently. Green sturgeon are thought to exhibit rearing behavior in the lower reaches of the Sacramento River and the Delta as juveniles and subadults prior to migrating to the ocean, though little is known about the behavior of these lifestages in the Delta (Radtke 1966; NMFS 2015a). Loss of riparian habitat complexity in the Sacramento River and Delta has likely posed less of a threat to green sturgeon because these life stages are benthically oriented. However, it is likely that reverse flows generated by Delta water exports affect the green sturgeon juvenile and subadult life stages to some degree as evidenced by juvenile captures at CVP/SWP salvage facilities during high water years (CDFW 2017; ftp://ftp.dfg.ca.gov/salvage).

Climate Change Impacts

One major factor affecting the rangewide status of the threatened and endangered anadromous fish in the Central Valley and aquatic habitat at large is climate change.

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

The magnitude of snowpack reductions is subject to annual variability in precipitation and air temperature. The large spring snow water equivalent (SWE) percentage changes, late in the snow season, are due to a variety of factors including reduction in winter precipitation and temperature increases that rapidly melt spring snowpack (Vanrheenen et al. 2004). Factors modeled by Vanrheenen et al. (2004) show that the melt season shifts to earlier in the year, leading to a large percent reduction of spring SWE (up to 100 percent in shallow snowpack areas). Additionally, an air temperature increase of 2.1°C (3.8°F) is expected to result in a loss of about half of the average April snowpack storage (Vanrheenen et al. 2004). The decrease in spring SWE (as a percentage) would be greatest in the region of the Sacramento River watershed, at the north end of the Central Valley, where snowpack is shallower than in the San Joaquin River watersheds to the south.

Projected warming is expected to affect Central Valley Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 5°C (9°F), it is questionable whether any Central Valley Chinook salmon populations can persist (Williams 2006). Based on an analysis of an ensemble of climate models and emission scenarios and a reference temperature from 1951–1980, the most plausible projection for warming over Northern California is 2.5°C (4.5°F) by 2050 and 5°C by 2100, with a modest decrease in precipitation (Dettinger 2005). Chinook salmon in the Central Valley are at the southern limit of their range, and warming will shorten the period in which the low elevation habitats used by naturally-producing fall-run Chinook salmon are thermally acceptable. This would particularly affect fish that emigrate as fingerlings, mainly in May and June, and especially those in the San Joaquin River and its tributaries.

Importance of the Action Area for the Survival and Recovery of Listed Fish Species

The action area defined for this Program includes critical habitat designated for all species of ESA-listed fish addressed in this opinion. It includes spawning habitat that is critical for the natural production of these species; rearing habitat that is essential for growth and survival during early life stages and enhances overall productivity and population health; migratory corridors that facilitate anadromous life history strategies; and estuarine habitat that serves as additional rearing habitat and provides a gateway to marine phases of their life cycle.

The NMFS Recovery Plan for the Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon ESUs and the California Central Valley Steelhead DPS (NMFS 2014) provides region-specific recovery actions that were identified by NMFS in order to facilitate recovery of these species. Implementation of some of these actions has already begun and more are in the planning phase. The Recovery Plan for sDPS green sturgeon has recently been completed, providing similar information and guidance for green sturgeon (NMFS 2018).

2.5 Effects of the Action

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

Of the proposed restoration project types, several types are expected to have only beneficial effects to listed species. Water conservation projects that occur beyond a diversion point (barrier to fish) do not interact with fish or their habitat and provide benefits by increasing instream water availability. Riparian habitat restoration actions occurring outside of the wetted channel and without disturbance to riparian vegetation are expected to have only beneficial effects to fish and their habitat. Other restoration project types are expected to include adverse effects, with some effect pathways limited to minor effects due to minimization measures, and other effect pathways expected to result in more substantive effects.

2.5.1 Project Effect Pathways with Minimal Effects

The following Program project types are expected to result in some minor adverse effects to listed species or habitat. The effect pathways, such as habitat disturbance from heavy equipment operation, riparian vegetation disturbance, or chemical contamination, are expected to be minimized due to incorporated measures.

Noise, Motion, and Vibration Disturbance from Heavy Equipment Operation

Noise, motion, and vibration produced by heavy equipment operation is expected at most instream restoration sites. However, the use of equipment, which will occur primarily outside the active channel, and the infrequent, short-term use of heavy equipment in the wetted channel to construct cofferdams, is expected to result in negligible effects to listed fishes. Listed salmonids and sturgeon will be able to avoid interaction with instream machinery by temporarily moving either upstream or downstream into suitable habitat adjacent to the worksite. In addition, the minimum distance between instream project sites and the maximum number of instream projects under the proposed Program would further reduce the potential aggregated effects of heavy equipment disturbance on listed fish. With the imposed Program limitations on the use of heavy equipment in the wetted channel and the proposed avoidance and minimization measures, NMFS anticipates a low level of effects within the action area as a result of these activities.

Disturbance to Riparian Vegetation

Impacts to riparian vegetation will be avoided to the maximum extent practicable. Disturbed riparian areas, not intended for future road access or gravel placement, will be revegetated with native plant species and mulched with certified weed-free hay within a year (timed to maximize survival) following the completion of construction activities. The temporary loss of riparian vegetation is an indirect effect of creating and maintaining temporary access points to the river, caused by covering vegetation with gravel; as well as a direct effect of temporary removal for floodplain and side channel enhancement. Most proposed fisheries restoration actions are expected to avoid disturbing riparian vegetation through the proposed conservation measures including the limitations on size of staging area, which will be no larger than 0.50 acres. In general, the restorative nature of these projects is expected and intended to improve habitat conditions for salmon and sturgeon, and thus riparian vegetation disturbance is expected to be avoided, as practicable. However, there may be limited situations where avoidance is not possible. In the event that streamside riparian vegetation is removed, the loss of riparian vegetation is expected to be small, due to minimization measures, and limited to mostly shrubs and an occasional tree.

Herbicide use for removal of invasive plant species could cause short-term impacts to sensitive fish species. Indirect impacts of herbicide use include the potential for short-term loss of shading and habitat provided by the invasive plants. The potential impacts to sensitive species are minimized by using the least toxic herbicides, surfactants, and spray pattern indicators available.

Further, any potential impacts to non-target plant species due to transport from rainfall and wind will be reduced through the use of avoidance and minimization measures. Section 1.3.6, *Protection Measures* provides general minimization measures for the application of herbicides with Section 1.3.5 providing more information on project type-specific measures. With the application of these avoidance and minimization measures, NMFS anticipates minimal loss of riparian vegetation, which is not expected to reduce habitat function within the action area as a result of these activities.

Chemical Contamination from Equipment Fluids

Equipment refueling, fluid leakage, and maintenance activities within and near the stream channel pose some risk of contamination and potential take. In addition to toxic chemicals associated with construction equipment, water that comes into contact with wet cement during construction of a restoration project can also adversely affect water quality and may harm listed fish. However, all fisheries restoration projects under the Program will include the measures outlined in the sections *Measures to Minimize Disturbance from Instream Construction* and *Measures to Minimize Degradation of Water Quality* within Part IX of the CDFW Manual, which address and minimize pollution risk from equipment operation, and *General Measures to Protect Water Quality and Limit Hazardous Materials* found in Section 1.3.6 *Protection Measures*. Therefore, water quality degradation from toxic chemicals associated with habitat restoration projects is not expected to occur.

2.5.2 Project Effects on the Species

Despite the differences in scope, size, intensity, and location of the proposed restoration actions, the potential incidental adverse effects to listed salmonids and sturgeon are expected to result in a more significant temporary effects, including from dewatering, fish relocation, physical disturbance and increased mobilization of sediment. Dewatering, fish relocation, and physical disturbance from structural/material placement are expected to result in direct effects to listed salmonids and sturgeon such that a small percentage of individuals are expected to be injured or killed. The effects from increased sediment mobilization are usually indirect effects because the effects to habitat, individuals, or both, are reasonably certain to occur but are expected later in time.

Exposure

Because the region-specific in-water work windows are designed to avoid the non-migratory life stages, the species and life stages most likely to be exposed to potential project effects are juvenile salmonids and sturgeon. While migrating adult fish may also be present, their mobility is expected to result in avoidance of the construction areas in most cases. Based on the species life histories detailed in Section 2.2, *Rangewide Status of the Species and Critical Habitat,* a small proportion of salmonids and sturgeon are expected to be present in each project site according to MU below:

Management Unit 1

The in-water work window for MU 1 is defined as October 1 – February 15, for the uppermost portion of the Sacramento River mainstem between Keswick Dam and RKM 391. The MU 1 in-water work window is protective of the "non-migratory" life stages of winter-run Chinook salmon because by October of a given year 100 percent of winter-run Chinook salmon fry will have emerged from the redds and about half of the winter-run Chinook salmon present will have reached the juvenile life stage (Vogel and Marine 1991; Martin et al. 2001). Adult winter-run Chinook salmon presence in MU 1 is expected to be relatively low with only 15-20 percent of the run arriving in the upper Sacramento River by mid-February. A small population of CV spring-run has persisted in MU 1 (NMFS 2016b), and during the in-water work window spring-run Chinook salmon presence would be comprised primarily of eggs and larvae, with an increasing proportion of juveniles in November – February. Adult spring-run Chinook salmon are mostly absent during the MU 1 work window with only about 5 percent having yet to spawn. Steelhead may also be present in MU 1 during the in-water work window as adults, with spawning occurring mid-December - April (peak in February) (McEwan 2001). Green sturgeon juveniles may be present year-round in MU 1 with the downstream migration of juveniles occurring October – February, typically at the same time as winter rain events (NMFS 2015b).

Management Unit 2

The in-water work window for MU 2 is defined as July 15 – October 31 for the portion of the Sacramento River mainstem between RKM 391 and RKM 333. The MU 2 in-water work window is protective of the "non-migratory" life stages of winter-run Chinook salmon as all spawning occurs upriver of the RBDD, and the only exposure would be to a small proportion of juveniles migrating downstream (Martin et al. 2001). A small proportion of CV spring-run Chinook salmon is expected to be present in MU 2 during the in-water work window mostly as adults migrating upriver to spawn (Yoshiyama et al. 1998). Steelhead may also be present in MU 2 (NMFS 2014) but because spawning and incubation occurs outside of the in-water work window, only a small juvenile and moderate adult presence is expected (Hallock 1989; McEwan 2001). For green sturgeon, there is significant overlap with the MU 2 in-water work window and timing of adult and juvenile presence; however, the typical timing of spawning and egg stage presence does not overlap (NMFS 2015b) with the work window.

Management Unit 3

The in-water work window for MU 3 is defined as June 1 through October 31 for the San Joaquin River mainstem and tributaries and the lower Sacramento River and tributaries (with only steelhead spawning). The in-water work window is protective of "non-migratory" life stages for CCV steelhead (such as egg incubation and emergence) for the San Joaquin River tributaries. There are no spawning winter-run Chinook salmon or green sturgeon in MU 3, but green sturgeon are present in the areas during the in-water work window covered by the management unit. And, although observations in the last decade suggest that spring-running populations may currently occur in the Stanislaus and Tuolumne rivers (Franks 2014), spawning has not been documented. Early migrating winter-run Chinook salmon could be present in the lower Sacramento River. According to Vogel and Marine (1991), approximately 20 to 75 percent of juveniles would have left the upper Sacramento river (and entered the lower river) by the end of October. A very low abundance (approximately less than 10 percent) of adult winter-run Chinook salmon would be present in the Sacramento River as 90 percent would have reached RBDD by June. Adult and juvenile green sturgeon may be present anytime of the year in the lower Sacramento River, where there could be some overlap for adults during the in-water work window in the months of June and October. Juvenile green sturgeon rear in the Sacramento River year-round, but overall it is expected that there will be relatively low abundance in the lower Sacramento River for both adults and juvenile green sturgeon. Migrating adult and juvenile CCV steelhead and spring-run Chinook salmon are present in MU 3. Early migratory adult CCV steelhead may begin their upstream migration in the mainstem of both the San Joaquin and Sacramento rivers during the month of October, however the presence of adults is dependent on in-river conditions such as flow and temperature (more likely in wet water years). Therefore, adult presence is expected to be relatively low. In addition, outmigrating juvenile steelhead may be present in the mainstem of both rivers in the month of June if habitat conditions are suitable (likely in wetter water years). The in-water work window avoids upstream migrating adult and outmigrating juvenile spring-run Chinook salmon. However, small numbers of juvenile spring-run Chinook salmon migrants may be passing through MU 3 in the month of June during wet water years.

Management Unit 4

The MU 4 in-water work window is defined as July 15 – September 30, and encompasses spring-run Chinook salmon spawning and holding habitat in the San Joaquin River mainstem and Sacramento River tributaries. These tributaries are outside of the spawning distribution of winter-run Chinook salmon and are therefore protective of that 'species' "non-migratory" life-stages. The migration timing of both spring-run Chinook salmon and steelhead is such that both species are expected to be present as adults during the in-water work window. Adult spring-run holding and spawning overlaps with the in-water work window where peak spawning occurs in September, such that 95 percent of spring-run will have finished spawning by October (Williams 2006). Although information on steelhead spawning is limited, spawning occurs from late December through April, so the "non-migratory" would not be present during the July 15 – September 30 in-water work window (Hallock et al. 1961; Johnson and Merrick 2012). Lastly, green sturgeon are not expected to be found in the tributaries of the Sacramento River, except for the Feather River (Seesholtz et al. 2015), where sexually mature adults are still found through September. Sampling in the mainstem Sacramento River indicates that spawning can occur from late in April through mid-June (Poytress et al. 2015a), therefore, the in-water work window will likely avoid the majority of green sturgeon eggs and larvae in MU 4.

Dewatering

Although most project types include the possibility of dewatering, not all individual project sites will need to be dewatered. In stream reaches where anadromous fish are present during construction, efforts will be made to design construction activities to avoid complete dewatering of a channel cross-section in a manner that maintains fish passage through the construction area. In cases where the entire channel cross-section must be dewatered, the maximum length of contiguous stream that can be dewatered is 1,000 feet.

Dewatering encompasses placing temporary barriers, such as a cofferdam, to isolate the work area, rerouting stream flow around the dewatered area, pumping water out of the isolated work area, relocating fish from the work area (discussed separately), and restoring the project site upon project completion.

Response and Risk

Stream flow diversion and project work area dewatering are expected to cause temporary loss, alteration, and reduction of aquatic habitat for salmonids and green sturgeon. The extent of temporary loss of juvenile rearing habitat is expected to be minimal because habitat at the restoration sites is typically degraded and the maximum length of contiguous stream that can be dewatered is 1,000 feet per project. These sites will be restored prior to project completion and are expected to be enhanced by the restoration project. Fluctuations in flow outside of dewatered areas are anticipated to be small, gradual, and short-term, which are not expected to result in any behavioral changes to salmonids or green sturgeon.

Effects associated with dewatering activities are expected to be minimized due to the multiple measures that will be used as described in Section 1.3.6 *Protection Measures*. Juvenile salmonids and juvenile green sturgeon that avoid capture and remain in the project work area are expected to die during dewatering activities. However, it is expected that the number of juveniles that will be killed as a result of barrier placement and stranding during site dewatering activities is very low, likely less than 1 percent of the total number of salmonids and sturgeon in the project footprint. The low number of juveniles expected to be injured or killed as a result of dewatering is based on the avoidance behavior of juveniles to disturbance, the small area affected during dewatering at each site, the low number of juveniles in the typically-degraded habitat conditions common to proposed restoration sites, and the low numbers of juvenile expected to be present within each project site after relocation activities.

Benthic (i.e., bottom dwelling) aquatic macroinvertebrate populations may be temporarily lost or their abundance reduced when creek habitat is dewatered (Cushman 1985). Effects to aquatic macroinvertebrates resulting from stream flow diversions and dewatering will be temporary because construction activities will be relatively short-lived, and rapid recolonization (about one to two months) of disturbed areas by macroinvertebrates (Cushman 1985; Attrill and Thomas 1996; Harvey 1986) is expected following the return of flow to the dewatered area. In addition, the effect of macroinvertebrate loss on salmonids and green sturgeon is likely to be negligible because food from upstream sources (via drift) would be available downstream of the dewatered areas since stream flows will be maintained around the project work site.

In consideration of the proposed in-water work windows, dewatering activities are expected to result in a reduction in the survival probability of juvenile salmonids and juvenile green sturgeon that avoid capture in the project work area. It is expected that the number of juveniles that will be killed as a result of barrier placement and stranding during site dewatering activities is very low, and likely less than one percent of the total number of salmonids and sturgeon in the project footprint. Because of their relative mobility, returning or holding adults present within the project vicinity are not expected to be affected by dewatering activities.

Fish Relocation Activities

All project sites that require dewatering will include fish relocation. A qualified biologist will capture and relocate fish away from the restoration project work site to minimize adverse effects of dewatering to listed anadromous fishes. Fish in the immediate project vicinity will be captured by seine, dip net and/or by electrofishing, and will then be transported and released to a suitable instream location.

Response and Risk

Fish relocation activities may injure or kill juvenile salmonids or green sturgeon present in the project sites. Any fish collecting gear, whether passive or active (Hayes 1983), has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of injury and mortality attributable to fish capture varies widely depending on the method used, the ambient conditions, and the expertise and experience of the field crew. The effects of seining and dip-netting on juvenile salmonids include stress, scale loss, physical damage, suffocation, and desiccation. Electrofishing can kill juvenile salmonids, and researchers have found serious sublethal effects including spinal injuries (Habera et al. 1996; Habera et al. 1999; Nordwall 1999; Holliman and Reynolds 2002; Nielsen and Johnson 1983). The long-term effects of electrofishing on salmonids are not well understood. Although chronic effects may occur, most effects from electrofishing occur at the time of capture and handling.

Most of the stress and death from handling result from differences in water temperature between the stream and the temporary holding containers, dissolved oxygen levels, the amount of time that fish are held out of the water, and physical injury. Handling-related stress increases rapidly if water temperature exceeds 18°C or dissolved oxygen is below the saturation concentration. The Program calls for a qualified biologist to relocate fish, following both CDFW and NMFS electrofishing guidelines. Because of these measures, direct effects to, and mortality of, juvenile fishes during capture are expected to be greatly minimized.

Although sites selected for relocating fish will likely have similar water temperature as the capture site and should have ample habitat, in some instances relocated fish may endure short-term stress from crowding at the relocation sites. Relocated fish may also have to compete with other salmonids, which can increase competition for available resources such as food and habitat. Some of the fish at the relocation sites may choose not to remain in these areas and may move either upstream or downstream to areas that have more habitat and lower fish densities. As each fish moves, competition remains either localized to a small area or quickly diminishes as fish disperse.

Effects associated with fish relocation activities will be significantly minimized due to the measures that will be utilized, as described in Section 1.3.6 *Protection Measures*, as well as project-specific measures described in Section 1.3.5. It is expected that fish relocation activities associated with implementation of individual restoration projects will not significantly reduce the number of returning listed salmonid adults. Data from two years (2002, 2003) of fish relocation activities in Humboldt County associated with habitat restoration projects authorized under the Corps' 1998 Regional General Permit for CDFW-funded restoration projects indicate mortality rates associated with individual fish relocation sites are less than 3 percent and the mean mortality rates for all sites are less than 1 percent (Collins 2004). A review of all Fisheries Restoration Grant Program (FRGP) annual monitoring reports of dewatering and relocation activities found that the highest percentage of steelhead killed was 0.56 percent across 99 projects that had dewatering during years 2002-2010 (NMFS 2017).

Fish relocation activities are expected to result in a reduction in the survival probability of juvenile salmonids and green sturgeon captured in the project work area. Based on similar projects, it is expected that the number of juveniles that will be killed as a result of capture and handling will be less than 1 percent of the total number of salmonids and sturgeon captured in the project vicinity. Because of their relative mobility, returning or holding adults present in the project vicinity are expected to avoid capture and therefore will not be affected by fish relocation activities.

Physical Disturbance

Most of the proposed restoration project types include the potential for placement of structures in the stream channel causing physical disturbance to the habitat. These structural placements can vary in their size and extent, depending on their restoration objective. Most structural placements are discrete, where only a localized area are expected to be affected.

Response and Risk

Physical disturbance of aquatic habitat may occur during construction activities and the placement of materials, which has the potential to affect the juvenile and adult life stages of salmonids and green sturgeon through displacement and disruption of normal behaviors. Direct injury or death may occur during instream construction activities from the installation of spawning gravel and instream habitat structures, and while grading the riverbed. Materials added to the riverbed and equipment working in the river could injure or kill salmonid and green sturgeon adults and juveniles. However, the number of juveniles injured or killed is expected to be no more than the number of individuals that will be killed by desiccation after the reach is dewatered without such structural placement. Fish relocation is expected to remove most salmonids. Juvenile fish that are not relocated are expected to be killed by either dewatering or structural placement.

During construction activities, both juvenile and adult fish will likely be able to detect areas of disturbance and will typically actively avoid those portions of the project footprint where equipment is actively operated or a turbidity plume occurs. Occasionally, feeding juvenile salmonids or sturgeon may be attracted to activity stirring up sediment, but whenever they detect an immediate threat, they are expected to quickly move away (Gregory, 1993; Tuomainen, & Candolin, 2011). Also, the area disturbed by gravel placement or excavation and associated turbidity at any given time is expected to be only a portion of the river width; therefore, juveniles will have opportunities to move to other portions of the channel where they can avoid potential injury or death. Adult salmonids and green sturgeon are expected to move out of the area to adjacent suitable habitat before equipment enters the water or before gravel, logs, or boulders are placed over them. Therefore, a potential impact to adult salmonids and green sturgeon from construction is considered extremely unlikely to occur.

Although juveniles are expected to avoid areas where equipment is being used to place or excavate gravel, some juvenile salmonids and juvenile green sturgeon may attempt to find shelter in the substrate and be injured or killed by equipment. Riffle supplementation sites, habitat structure placement, and floodplain and side channel enhancement sites may require the application of gravel directly to the riverbed, grading of the material, placement of river crossings at some sites, and the use of heavy equipment in the river, thereby increasing the likely exposure and chance for adverse effects to listed juveniles in the area. Nonetheless, the majority of gravel augmentation activities will occur within shallow areas in the middle of the channel, where fewer juveniles are expected to be rearing, given their preference for the channel margins. Studies indicate that juvenile salmonids tend to be found within 10-20 feet of riverbanks (Allen 2000; FISHBIO LLC 2012a). There is limited information regarding habitats occupied by juvenile green sturgeon; however, "habitat preference… in the laboratory suggests that wild juveniles should be in deep pools with some rock structure" (Kynard et al. 2005). Therefore, a low number of juveniles are expected to be injured or killed as a result of physical disturbance based on the avoidance behavior of juveniles to disturbance, the small area affected during construction activities at each site, and limited number of juveniles present due to lack of suitable habitat in the construction areas.

Increased Mobilization of Sediment

All project types involving ground disturbance in or adjacent to streams are expected to increase turbidity and suspended sediment levels within the project work site and downstream areas. The re-suspension and deposition of instream sediments is an indirect effect of construction equipment and gravel entering the river. Short-term increases in turbidity and suspended sediment levels associated with construction may negatively impact fish populations temporarily through reduced availability of food, reduced feeding efficiency, and exposure to sediment released into the water column.

Response and Risk

Short-term increases in turbidity are anticipated to occur during dewatering activities and/or during construction. Research with salmonids has shown that elevated turbidity and suspended sediment levels have the potential to adversely affect all freshwater life stages by clogging or abrading gill surfaces, adhering to eggs, hampering fry emergence (Phillips and Campbell 1961), burying eggs or alevins, scouring and filling in pools and riffles, reducing primary productivity and photosynthesis activity (Cordone and Kelley 1961), and affecting intergravel permeability and dissolved oxygen levels (Zimmermann and Lapointe 2005; Lisle and Eads 1991). Fish behavioral and physiological stress responses include gill flaring, coughing, avoidance, and increased blood sugar levels (Berg and Northcote 1985; Servizi and Martens 1992). Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning and egg and fry survival (Waters 1995). Although small pulses of turbid water can cause salmonids to disperse from established territories moving fish into less suitable habitat and/or increase competition and predation, the proposed protection measures are likely sufficient to avoid substantial impacts. Further, much of the research mentioned above focused on turbidity levels significantly higher than those expected to result from the proposed restoration activities.

The concentrations of sediment and turbidity expected from the proposed restoration activities are not expected to be severe enough to cause injury or death of listed juvenile fishes. Instead, the anticipated minor levels of turbidity and suspended sediment resulting from instream restoration projects are expected to result in temporary behavioral effects. Behavioral effects can often be minimal movements to adjacent areas, or can lead to reduced survival (through higher likelihood of predation) and growth (through reduced feeding). Monitoring of newly replaced culverts in Humboldt County, California, have detailed a range in turbidity changes downstream of replaced culverts following winter storm events (NMFS 2017). Although the culvert monitoring results show decreasing sediment effects as projects age from year one to year three, a more important consideration is that most measurements fell within or below the 100 to 150 NTU range which could impair feeding (Gregory and Northcote 1993; Harvey and White 2008). Importantly, proposed minimization measures are designed to ensure that future sediment effects from fish passage projects will be small. Compared to other restoration projects, the behavioral effects expected as a result of restoration activities covered under the Program are not likely to be more severe than a short-term reduction in feeding.

Sediment effects generated by each individual project will likely impact only the immediate footprint of the project site and habitat located immediately downstream. Studies of sediment effects during culvert construction determined that increased sediment accumulation within the streambed was measurable (relative to control levels within) at a range of 358 to 1,442 meters downstream of the culvert (Lachance et al. 2008). With the measures to minimize sediment mobilization, described in Sections 1.3.5 and 1.3.6, as well as the limits to the temporal and spatial scale of project activities, sediment-related effects are expected to be small. Finally, effects to fish are expected to be short-term, since most project-related sediment will likely mobilize only during the initial high-flow event during the following winter season.

2.5.3 Project Effects to Critical Habitat

Although some habitat restoration projects may cause minor short-term adverse effects to the critical habitat of listed species, all restoration projects are designed and anticipated to improve habitat PBFs resulting in benefits to listed species over the long-term. Furthermore, the restoration sites selected will be of a degraded quality such that the benefit to critical habitat is expected to outweigh any temporary negative impacts. The description below describes both adverse and beneficial impacts to critical habitat of listed species.

Critical habitat PBFs for all listed species may be adversely impacted due to components of restoration activities. These PBFs include spawning, rearing, and migration habitats. The critical habitat designation for green sturgeon identified PBFs considered essential for the conservation of the DPS. Green sturgeon PBFs that may be adversely impacted by restoration actions include water quality, migratory pathway, and sediment quality.

The potential, adverse effects to critical habitat are expected to follow the same effects pathways as the effects to species, primarily caused by dewatering, physical disturbance and increased mobilization of sediment. These effects may be caused by a number of different projects types, but all are expected to be short-term.

Salmonids

Juvenile rearing sites require cover and cool water temperatures during the summer low flow period. Over-wintering juvenile salmonids require refugia to escape to during high flows in the winter. Temporary adverse effects to rearing habitat PBFs will primarily occur as a result of dewatering the channel and increasing sediment input during instream activities. However, these adverse effects are expected to be temporary and of short duration lasting only as long as project construction or until the first fall storm or spring freshet. The activities described in the proposed action will increase quality of rearing habitat over the long term. Rearing habitat will be improved by adding complexity that will increase pool formation, cover structures, and velocity refugia.

Spatially explicit in-water work windows are designed to avoid impacts to salmonid spawning habitat during the spawning season(s) and egg incubation. The limited cases of affected spawning habitat PBFs are expected to include temporary increases in fine sediment resulting from proposed activities. Spawning habitat is located where water velocities are higher, where mobilized fine sediment is less likely to settle. Where limited settling does occur in spawning habitat, the minimally increased sediment is not expected to degrade spawning habitat due to the small amounts and short-term nature of the effects.

Migratory habitat PBFs are essential for juvenile salmonids outmigrating to the ocean as well as adults returning to their natal spawning grounds. Migratory habitat PBFs may be affected during the temporary re-routing of the channel during project implementation, however, the Program's *General Measures to Limit the Effect of Dewatering Activities and Fish Relocation* requires that a migratory corridor will be maintained at all times. The proposed action will also have long-term beneficial effects to migratory habitat. Activities adding complexity to migratory habitat PBFs are expected to increase the number of pools, providing resting areas for adults, and the removal of barriers expected to improve access to habitat.

Green Sturgeon

While limited information is known about the rearing and foraging suitable habitat requirements of Southern DPS green sturgeon, PBFs of water flow, water quality, migratory corridor, and depth, may be affected by construction activities, including localized disturbance to habitat. Project actions may increase sediment, silt, and pollutants, which could adversely affect PBFs including water quality or reduce production of food, such as aquatic invertebrates, for larval and juvenile green sturgeon. However, similar to the discussion of salmonid critical habitat, these adverse effects are expected to be temporary and of short duration.

Also similar to salmonids, green sturgeon require a migratory pathway necessary for the safe and timely passage of juveniles and adults. Migratory habitat PBFs may be affected during the temporary re-routing of the channel during project construction, however any migratory delays will be temporary and likely have little impact on the success of migration.

2.5.4 Beneficial Effects by Project Type

By Program definition a "restoration project" is one that will result in a net increase in aquatic or riparian resource functions and services. All projects are expected to have some long-term benefit to species, primarily through increased quantity or quality of the PBFs of critical habitat. Unlike the assessment of the potential adverse impacts to critical habitat, where effects are described by the construction activities common to multiple project types, the beneficial effects are described specific to individual project types.

Instream Habitat Improvements

Instream habitat structures and improvement projects are expected to provide escape from predators and resting cover, increase spawning habitat, improve upstream and downstream migration corridors, improve pool to riffle ratios, and add habitat complexity and diversity. Some structures will be designed to reduce sedimentation, protect unstable banks, stabilize existing slides, provide shade, and create scour pools. Instream habitat structures such as woody material and boulders contribute to habitat diversity and create and maintain foraging, cover, and resting habitat for both adult and juvenile anadromous fish. Placement of instream woody material on the banks of the active channel will create instantly available habitat by creating diverse cover for juvenile rearing. Activities described in the proposed action are expected to improve the quality of spawning habitat over the long term. Spawning habitat is expected to be improved by reducing the amount of fine sediment that enters the stream in the long term through various types of erosion control. Additionally, gravel augmentation, described in the proposed action, is expected to increase the amount of spawning habitat available.

Fish Passage Improvement

Instream barrier modification for fish passage improvement projects will improve fish passage and increase access to suitable habitat. Long-term beneficial effects are expected to result from these projects by improving passage at sites that are partial barriers, or by providing passage at sites that are total barriers.

Reestablishing the linkages between mainstem migratory habitat and headwater spawning/ rearing habitat will greatly facilitate the recovery of listed species throughout the action area. Improving listed salmonid passage into previously inaccessible upstream habitat is expected to increase reproductive success and ultimately fish population size in watersheds where the amount of high quality freshwater habitat is a limiting factor.

Bioengineered Stream Bank Stabilization

Bioengineered stream bank stabilization projects are expected to reduce sedimentation from bank erosion, decrease turbidity levels, and improve water quality for salmonids and green sturgeon over the long-term. Reducing fine sediment delivery to the stream environment is expected to improve fish habitat and fish survival by increasing fish embryo and alevin survival in spawning gravels, reducing injury to juveniles from high concentrations of suspended sediment, and minimizing the loss of quality and quantity of pools from excessive sediment deposition. In addition, the various proposed streambank restoration activities are expected to enhance native riparian forests or communities, provide increased cover (large wood, boulders, vegetation, and bank protection structures) and a long-term source of all sizes of instream wood.

Fish Screens

Fish screens are commonly used to prevent entrainment of juvenile fish in water diverted for agriculture, power generation, or domestic use. There are at least 3,356 diversions for taking water from the Sacramento and San Joaquin Rivers, their tributaries, and the Delta (Herren and Kawasaki 2001). Nearly all (98.5 percent) of these diversions are "either unscreened or screened insufficiently to prevent fish entrainment" (Herren and Kawasaki 2001). Once entrained, juvenile fish can be transported to less favorable habitat (e.g., a reservoir, lake or drainage ditch) or killed instantly by turbines.

Fish screens substantially decrease juvenile fish loss in stream reaches where surface flow is regularly diverted out of channel. Surface diversions vary widely in size and purpose, from small gravity fed diversion canals supplying agricultural water to large hydraulic pumping systems common to municipal water or power production. All screening projects have similar goals, most notably preventing fish entrainment into intake canals and impingement against the mesh screen. To accomplish this, all screening projects covered by this opinion will follow current guidelines drafted by CDFW and NMFS which outline screen design, construction, placement, and implementation of successful juvenile bypass systems that return screened fish back to the stream channel.

Fish screen projects are expected to reduce the risk for fish being entrained or sucked into irrigation systems. Well-designed fish screens and associated diversions ensure that fish injury or stranding is avoided, and fish are able to migrate through stream systems at the normal time of year.

Riparian Habitat Restoration

Riparian vegetation, particularly shaded riverine aquatic habitat, provides overhead cover and a substrate for food production for juvenile salmonids and green sturgeon. The shade from the vegetation helps to cool water temperatures in the river and seasonally provides insects for fish to forage. Shaded habitat is important to juvenile salmon and steelhead as they migrate down the river to the sea. Terrestrial insects that live on riparian vegetation fall into the river and provide an important food source for fish. Riparian trees and shrubs will eventually end up in the river channel as floods erode the bank or sweep them from the floodplain. Once in the river channel, the stems, trunks, and branches become very important structural habitat components for aquatic life, including fish (Robison and Beschta 1990). Most of the aquatic invertebrates found in the river occur on the woody debris. These invertebrates, in turn, are the primary food of juvenile salmon and steelhead. Large wood affects the hydraulics of flows around it that results in a more complex channel geomorphology and the storage of spawning gravels.

Riparian restoration projects are expected to improve shade and cover, protecting rearing juveniles, reducing stream temperatures, and improving water quality through pollutant filtering. Beneficial effects of constructing livestock exclusionary fencing in or near streams include the rapid regrowth of grasses, shrubs, and other vegetation released from overgrazing and the reduction of excessive nitrogen, phosphorous, and sediment loads in the streams (Line 2003; Brenner 1999). Another documented, beneficial, long-term effect is the reduction in bankfull width of the active channel and the subsequent increase in pool area in streams (Magilligan and McDowell 1997; Corenblit et al. 2007). All are expected to contribute to a more properly functioning ecosystem for listed species by providing additional spawning and cover habitat.

2.6 Cumulative Effects

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

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

Unscreened Water Diversions

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the California Central Valley. Thousands of small and medium-size water diversions exist along the Sacramento River, San Joaquin River, their tributaries, and the Delta, and many of them remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile listed anadromous species (Mussen et al. 2013; Mussen et al. 2014). For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001). Most of the 370 water diversions operating in Suisun Marsh are unscreened (Herren and Kawasaki 2001).

Agricultural Practices

Agricultural practices may negatively affect riparian and wetland habitats through upland modifications that lead to increased siltation or reductions in water flow in stream channels flowing into the action area, including the Sacramento River and Delta. Grazing activities from dairy and cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation, as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which then flow into receiving waters. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may disrupt various physiological mechanisms and may negatively affect reproductive success and survival rates of listed anadromous fish (Scott and Sloman 2004).

Increased Urbanization

According to the Delta Protection Commission's Economic Sustainability Plan, the population within the Legal Delta experienced a 56 percent increase from 1990 to 2010, while California as a whole experienced a 25 percent increase over that time period (Delta Protection Commission 2012). The prediction of continued increased urbanization and housing developments will likely impact habitat by altering watershed characteristics and changing both water use and stormwater runoff patterns. Increased growth will place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions, particularly those which are situated away from waterbodies, will not require Federal permits, and thus will not undergo review through the ESA section 7 consultation process with NMFS.

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

Wastewater Treatment Plants

Two wastewater treatment plants (one located on the Sacramento River near Freeport and the other on the San Joaquin River near Stockton) have received special attention because of their discharge of ammonia. The Sacramento Regional Wastewater Treatment Plan (SRWTP), in order to comply with Order no. R5-2013-0124 of the Central Valley Regional Water Quality Control Board (CVRWQCB), has begun implementing compliance measures to reduce ammonia discharges. Construction of treatment facilities for three of the major projects required for ammonia and nitrate reduction was initiated in March 2015 (Sacramento Regional County Sanitation District 2015). Order no. R5-2013-0124, which was modified on October 4, 2013, by the CVRWQCB, imposed new interim and final effluent limitations, which must be met by May 11, 2021 (CVRWQCB 2013). By May 11, 2021, the SRWTP must reach a final effluent limit of 2.0 milligrams per liter (mg/L) per day from April to October and 3.3 mg/L per day from November to March (CVRWQCB 2013). However, the treatment plant is currently releasing several tons of ammonia in the Sacramento River each day.

In 2013, EPA published revised national recommended ambient water quality criteria for the protection of aquatic life from the toxic effects of ammonia. However, few studies have been conducted to assess the effects of ammonia on Chinook salmon, steelhead, or sturgeon. Studies of ammonia effects on various fish species have shown numerous effects including membrane transport deficiencies, increases in energy consumption, immune system impairments, gill lamellae fusions deformities, liver hydropic degenerations, glomerular nephritis, and nervous and muscular system effects leading to mortality (Connon et al. 2011). Additionally, a study of Coho salmon and rainbow trout exposed to ammonia showed a decrease in swimming performance due to metabolic challenges and depolarization of white muscle (Wicks et al. 2002).

Changes in Location, Volume, Timing, and Method of Delivery for Non-CVP and Non-SWP Diversions

Changes in location, volume, timing, and method of delivery for non-Central Valley Project and non-State Water Project diversions not previously included in the section 7 Effects Analysis of the 2008 biological assessment for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project may be fully or partially implemented without Federal consultation. While the details of implementation are not certain, changes may be expected to occur due to:

- Implementation of the California Sustainable Groundwater Management Act that requires development and implementation of Groundwater Sustainability Plans;
- Implementation of the California Senate Bill X7-7 provisions which require the state to achieve a 20 percent reduction in urban per capita water use by December 31, 2020;
- Implementation of the California 2009 Delta Reform Act (implementation of portions of the Delta Reform Act also is part of the California Water Action Plan);
- Implementation of the California Water Action Plan released by Governor Jerry Brown in January 2014, specifically, for provisions of the plan that would not necessarily require separate environmental documentation and consultation for related Federal actions.

NMFS does not have information on the specific impacts from these programs to listed fish species or critical habitat at this time; thus, NMFS cannot determine the specific impacts of these programs. NMFS expects that habitat restoration activities under the California Water Action Plan would have short-term effects (sedimentation, turbidity, acoustic noise, temporary habitat disturbance) similar to effects discussed in this opinion for similar habitat restoration project types (see Section 1.3.5 *Project Types and Prohibited Activities*). In general, NMFS expects that implementation of these programs will improve habitat conditions for listed fish into the future through the increased availability of instream flows and Delta habitat restoration.

Other Activities

Other future, non-Federal actions within the action area that are likely to occur and may adversely affect Chinook salmon, steelhead, and green sturgeon and their critical habitat include: the dumping of domestic and industrial garbage that decreases water quality; oil and gas development and production that may affect aquatic habitat and may introduce pollutants into the water; and state or local levee maintenance that may also destroy or adversely affect habitat and interfere with natural, long term habitat-maintaining processes.

Power plant cooling system operations can also affect aquatic habitat. Contra Costa Power Plant, which was owned and operated by NRG Delta, LLC, was retired in 2013 and replaced with the

Marsh Landing Generating Station. The Pittsburg Generating Station (PGS) remains in operation and consists of seven once-through cooling systems, four of which have been retired, one of which is in the process of being retired, and two of which remain in operation. The once-through cooling system intake process can cause the impingement and entrainment of marine animals, kill organisms from all levels of the food chain, and disrupt the normal processes of the ecosystem. Additionally, the plant can discharge heated water that can reach temperatures as high as 100°F into the action area. This sudden influx of hot water can adversely affect the ecosystem and the animals living in it (San Francisco Baykeeper 2010).

On May 4, 2010, the SWRCB adopted a Statewide Policy on the Use of Coastal and Estuarine Water for Power Plant Cooling under Resolution No. 2010–0020, which required existing cooling water intake structures to reflect the best technology available for minimizing adverse environmental impacts (SWRCB 2010). The PGS was required to submit an implementation plan to comply with this policy by December 31, 2017, and the PGS chose to comply by retrofitting two of the existing units and retiring one unit (GenOn Delta LLC 2011).

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 opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminishes the value of designated or proposed critical habitat for the conservation of the species.

2.7.1 Cumulative Effects

The Cumulative Effects section (Section 2.6) of the opinion describes future state, tribal, local, or private actions that are reasonably certain to occur in the action area. For this opinion, these include unscreened water diversions and the point and non-point source chemical contaminant discharges related to agricultural and urban land use. These actions typically result in habitat fragmentation and degradation of habitats that incrementally reduces the carrying capacity of the rearing and migratory corridors found within the action area. Cumulative effects also include the implementation of changes in state law and the California Water Action Plan as outlined in Section 2.6 *Cumulative Effects*, which could change the location, volume, timing, and method of delivery for non-Central Valley Project and non-State Water Project diversions not previously included in the section 7 Effects Analysis of the 2008 biological assessment for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project (Reclamation 2008) which may be fully or partially executed without Federal consultation. The effect of these actions, while uncertain, are expected to provide greater oversight of water use and associated water quality which would improve conditions for aquatic species in the action area.

2.7.2 Status of the Species and Environmental Baseline

The status of the species and environmental baseline for species have been described in Sections 2.2 and 2.4, respectively. Critical to the integration and synthesis of effects are the VSP parameters of abundance, productivity, spatial structure, and diversity. Because these parameters are consistent with the "reproduction, numbers, or distribution" criteria found within the regulatory definition of jeopardy (50 CFR 402.02), the VSP parameters are used as surrogates for the jeopardy criteria. These VSP parameters are used to establish the reference condition of a population in the status of the species and environmental baseline and where an appreciable change to these parameters is used to assess the risk to the population and the risk to the ESU.

Sacramento River Winter-run Chinook Salmon

As described in Section 2.2, *Rangewide Status of the Species and Critical Habitat*, the SR winter-run Chinook salmon ESU was first listed as threatened in 1989 (54 FR 32085), reclassified as endangered in 1994 (59 FR 440), and then reaffirmed as endangered in 2005 (70 FR 37160).

Based on the most recent status review, several criteria qualify the one remaining population of winter-run Chinook salmon as being at moderate risk of extinction, though only one criterion is required. However, because this ESU is limited to the single population that spawns below Keswick Dam, the winter-run Chinook salmon ESU is at high risk of extinction in the long-term according to criteria in Lindley et al. (2007). Recent trends in those criteria are:

(1) continued low abundance;

(2) a negative growth rate over 6 years (2006–2012), which is two complete generations;

(3) a significant rate of decline since 2006;

(4) increased hatchery influence on the population; and

(5) increased risk of catastrophe from oil spills, wild fires, or extended drought (i.e., realization of effects of climate change).

The most recent 5-year status review (NMFS 2016c) on winter-run Chinook salmon concludes that the extinction risk of this ESU has increased since the last status review largely due to extreme drought and poor ocean conditions.

Central Valley Spring-run Chinook Salmon

The Central Valley Spring-run Chinook Salmon ESU was first listed as threatened in 1999 (64 FR 50394) and then reaffirmed in 2005 70 FR 37160), with the experimental, non-essential population designated in 2013 (78 FR 79622).

Overall, because the populations in Butte, Deer and Mill creeks are the best trend indicators for ESU viability, we can evaluate risk of extinction based on VSP parameters in these watersheds. Lindley et al. (2007) indicated that the spring-run Chinook salmon populations in the Central

Valley had a low risk of extinction in Butte and Deer creeks, according to their population viability analysis (PVA) model and other population viability criteria (i.e., population size, population decline, catastrophic events, and hatchery influence, which correlate with VSP parameters abundance, productivity, spatial structure, and diversity). The Mill Creek population of spring-run Chinook salmon was at moderate extinction risk according to the PVA model, but appeared to satisfy the other viability criteria for low-risk status. However, the CV spring-run Chinook salmon ESU failed to meet the "representation and redundancy rule" since there are only demonstrably viable populations in one diversity group (northern Sierra Nevada) out of the three diversity groups that historically contained them, or out of the four diversity groups as described in the NMFS Central Valley Salmon and Steelhead Recovery Plan. Over the long term, these three remaining populations are considered to be vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other. Drought is also considered to pose a significant threat to the viability of the spring-run Chinook salmon populations in these three watersheds due to their close proximity to each other. Therefore, the extinction risk for the CV spring-run Chinook salmon ESU remains at moderate risk of extinction (NMFS 2016b). Based on the severity of the drought and the low escapements as well as increased pre-spawn mortality in Butte, Mill, and Deer creeks in 2015, there is concern that these CV spring-run Chinook salmon strongholds will further deteriorate into high extinction risk based on the population size or rate of decline criteria (NMFS 2016b). The most recent years of monitoring data provide validity to this concern as the 2017, 3-year running average escapement, was the lowest it has been in over 30 years for Mill and Deer Creeks combined (CDFW 2018).

California Central Valley Steelhead

The California Central Valley Steelhead DPS was first listed as threatened in 1998 (63 FR 13347) and then reaffirmed as threatened in 2006 (71 FR 834).

All indications are that natural origin CCV steelhead abundance, and the proportion of natural origin steelhead in the DPS, has continued to decrease over the past 25 years (NMFS 2016a). Hatchery production and returns are dominant over natural origin steelhead, with hatchery releases (100 percent adipose fin-clipped fish since 1998) remaining relatively constant over the past decade, but the proportion of adipose fin-clipped hatchery smolts to unclipped naturally produced smolts has steadily increased over the same period.

Using data through 2005, Lindley et al. (2007) found that data were insufficient to determine the status of any of the naturally-spawning populations of CCV steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas. And although the widespread distribution of natural origin steelhead in the Central Valley provides the spatial structure necessary for the DPS to survive and avoid localized catastrophes, most natural origin CCV steelhead populations are very small and may lack the resiliency to persist for protracted periods if subjected to additional stressors. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery origin steelhead relative to natural origin fish. In consideration of these conditions, the most recent status review of the CCV steelhead DPS (NMFS 2016a) found that the status of the DPS has not changed since the 2011 status review.

Green Sturgeon

The Green Sturgeon sDPS was listed as threatened in 2006 (71 FR 17757).

The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into a limited section of the river. And although the population structure of sDPS green sturgeon is still being refined, it is currently believed that only one population of sDPS green sturgeon exists. Lindley et al. (2007), in discussing SR winter-run Chinook salmon, stated that an ESU represented by a single population at moderate risk of extinction is at high risk of extinction over the long run. This concern applies to any DPS or ESU represented by a single population, and if this were to be applied to sDPS green sturgeon directly, it could be said that sDPS green sturgeon face a high extinction risk. However, NMFS concludes that the extinction risk is moderate because, although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the accuracy of population abundance indices (NMFS 2010a).

Summary of Proposed Action Effects on the Species

Restoration projects authorized under the Program are for the purpose of restoring anadromous fish habitat. As such, proposed projects under the Program are expected to result in benefits to listed species. As described above, some projects include components that are expected to result in minor or temporary adverse effects (e.g., sediment mobilization), while other components are expected to result in more substantive adverse effects (e.g., relocation activities). NMFS anticipates less frequent substantive adverse effects resulting in short-term behavioral changes, or resulting in small numbers of juvenile salmon, steelhead, and/or green sturgeon to be injured or killed at each individual restoration project work site. This includes those fish present in the project work area, that will be subject to capture, relocation, and related stresses. Any unintentional mortalities of listed species during dewatering and fish relocation activities are expected to occur exclusively at the juvenile stage. More frequent and minor effects are expected to occur to listed anadromous fish present during project construction, including disturbance, and displacement to adjacent habitat.

Short-term impacts to listed species from restoration activities will be minimal and localized at each project site. The duration and magnitude of direct effects associated with implementation of individual restoration projects to listed salmonids and green sturgeon are expected to be significantly minimized due to the minimization measures that will be used during implementation. The temporal and spatial limits (i.e., MU-specific work-windows) included in the proposed action will minimize effects to the most vulnerable non-migratory life stages, thereby avoiding the most significant impacts to the productivity and spatial structure VSP parameters for an ESU/DPS. Further, NMFS anticipates the effects of individual restoration projects will not reduce the number of returning listed salmonid adults which would otherwise affect the abundance VSP parameter for a species. Even though salmonid and sturgeon numbers are dramatically reduced from historical abundance in the affected ESU and DPSs, juvenile losses are expected to be very small compared to the total number of juveniles that continue to rear each year and in the action area. The small losses that do occur are unlikely to affect the VSP parameters at the population level in a watershed or at the level of the ESU/DPS. Lastly, the low numbers of juvenile fish anticipated to be captured, injured or killed will be dispersed over a large geographic area and therefore reduce the effect to the spatial structure and diversity VSP parameters by not concentrating all effects on any one population.

Given that the VSP parameters for each ESU/DPS are not expected to be significantly reduced by the proposed action, NMFS has determined the effects of the action, when added to the environmental baseline and cumulative effects, are not expected to appreciably reduce the numbers, distribution or reproduction of salmon, steelhead and/or green sturgeon within each watershed where restoration projects occur, or within their respective ESU/DPS. This is based on the Program's numeric limit on concurrent projects each year (maximum of 60), that projects are spaced across a large geographic area, and that projects have required minimization and avoidance measures that result in short-term effects from restoration project construction. All of the restoration projects are intended to restore degraded salmonid and sturgeon habitat and improve instream cover, pool habitat, and spawning gravel; remove barriers to fish passage; and reduce or eliminate erosion and sedimentation impacts. These restoration projects are selected based the priorities set forth in current recovery plans and in close coordination with CDFW and NMFS staff biologists working in watershed recovery areas. Projects are generally prioritized based on the population structure with priority given to independent populations that are a priority for achieving viability across ESUs and DPSs. With improvements in population viability these populations are expected to become more resistant and resilient to climate change impacts (which are likely to increase in the action area and across the ESUs and DPSs) as the Program continues into the future. As such, the Program as is expected to result in an increase of listed species survival, and be an aid to recovery.

2.7.3 Status of Critical Habitat and Environmental Baseline

Currently accessible salmonid and sturgeon habitat throughout the action area has been severely degraded, and the condition of designated critical habitats, specifically their ability to provide for long-term salmonid and sturgeon conservation, has also been degraded from conditions known to support viable populations. Intensive land and stream manipulation during the past century (e.g., logging, agricultural/livestock development, mining, urbanization, and river dams/diversion) has modified and eliminated much of the historic anadromous fish habitat in the Central Valley of California. For salmonids the status of critical habitat in the environmental baseline has many PBFs that are impaired, to the extent of limiting the availability (and accessibility) of high quality habitat. For example, the critical habitat currently includes a number of features that reduce the quality of migratory corridors for juveniles including passage impediments, altered Delta flows, and a lack of floodplain habitat. In addition, current water operations can limit the spatial extent of cooler-water habitat downstream of dams, which reduces the available habitat for spawning and egg incubation (based on water temperature suitability). Likewise, many of the PBFs of sDPS green sturgeon designated critical habitat are currently degraded or impaired and provide limited high quality habitat. Features that lessen the quality of migratory corridors and rearing habitat for juvenile green sturgeon include unscreened or inadequately screened diversions, altered flows in the Delta, and the presence of contaminants in sediment. Although the current conditions of salmonid and sturgeon critical habitat are significantly degraded, the remaining habitat for spawning and egg incubation, migratory corridors, and rearing is considered to have high intrinsic value for the conservation of the species.

2.7.4 Summary of Proposed Action Effects to Critical Habitat

NMFS expects minor, short-term impacts to listed salmonid and sturgeon designated critical habitat associated with the projects implemented each year under the Program. However, projects implemented are expected to provide long-term improvements to anadromous fish habitat in the Central Valley. NMFS also anticipates that the additive, beneficial effects to instream salmonid and sturgeon habitat conditions would accrue over multiple generations of salmon and sturgeon, which will improve the condition of local populations into the future. As identified in the NMFS Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014), "the restoration of functioning, diverse and interconnected habitats is necessary for a species to be viable." Impediments to species recovery, such as habitat loss and fragmentation caused by barriers to migration are expected to be reduced or reversed as a result of implementing the proposed action.

In addition to decreasing threats to recovery, the restoration of specific PBFs of habitats is expected to result in improvements to adult spawning success, juvenile survival, and smolt outmigration, which will in turn promote improved VSP parameters of abundance, productivity, spatial structure, and diversity for individual populations. As PBFs of critical habitat improves, we expect individual population viability to improve, and the viability of the ESUs and DPSs are expected to improve as well. Based on our analysis, NMFS concludes that the proposed action is not expected to appreciably diminish, rather it is expected to increase the value of designated critical habitat for the conservation of listed salmon and sturgeon species in the Central Valley.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, Southern DPS of North American green sturgeon or destroy or adversely modify designated critical habitat for these listed species.

2.9 Incidental Take Statement

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

2.9.1 Amount or Extent of Take

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

Under the Program, incidental take is expected to occur during dewatering, fish relocation activities, and the placement of structures or materials in the wetted stream channel causing physical disturbance to the habitat at individual project sites. In stream reaches where anadromous fish are expected to be present during construction, efforts will be made to design construction activities to maintain continued volitional fish passage through the construction area by avoiding the complete dewatering of the channel cross-section. At project sites where the entire channel cross-section must be dewatered, the maximum length of contiguous stream that can be dewatered is 1,000 feet. In estimating take for projects not requiring dewatering, the take associated with physical disturbance is expected to be no greater than the number of individuals that would otherwise be killed by desiccation after the reach was dewatered. Given this expectation, the take associated with physical disturbance is considered equivalent to the take associated with dewatering, and therefore the estimate of the number of fish harmed by dewatering activities also applies to the take associated with physical disturbance.

Given the precedent of other programmatic NMFS opinions for restoration in the coastal regions (NMFS Arcata and Santa Rosa Offices), and the similarity of fish capture and relocation methods to be employed in the action area for the Program, we assume that on average, fish will be injured or killed on a per-project basis similar to that experienced during implementation of Arcata and Santa Rosa Office opinions (NMFS 2012; 2016). Using the fish mortality data recorded for all projects from 2009 – 2017 (NMFS 2017) with an observed 3 percent mortality based on rate of fish capture at restoration sites (Collins 2004); we back calculate the estimated number of fish captured per project (restoration project practitioners were only required to report mortalities). For the period of 2009 – 2017, a total of 1,126 Chinook killed equates to an estimated 37,533 fish captured across 452 restoration projects; 1,546 steelhead killed equates to an estimated 51,533 fish captured during 536 restoration projects; and 1 green sturgeon killed equates to an estimated 33 fish captured during 23 restoration projects. On a per-project basis, the estimated number of Chinook captured would be 83; steelhead 96; and green sturgeon 1.

NOAA RC program data (from the Arcata and Santa Rosa Offices) as well as data from CDFW's Fisheries Restoration Grant Program (FRGP) annual reports to NMFS show that approximately 10 percent of restoration projects involve the placement of structures or materials in the wetted channel or dewatering. We assume this percentage is a reasonable estimate of the frequency of physical disturbance and dewatering expected for projects in the action area of the Program. Given a 10 percent physical disturbance and dewatering rate and a maximum of 60 concurrent projects per year under this Program, an estimated 6 projects per year would involve physical disturbance and dewatering.

Based on the above assumptions, the proposed action will result in incidental take of listed juvenile Chinook salmon, juvenile steelhead, and green sturgeon during the 10-year timeframe of this programmatic opinion. Chinook salmon, steelhead, and green sturgeon will be captured, injured and/or killed by the placement of structures or materials in the wetted channel, dewatering of the channel or fish relocation activities at project sites. Incidental take is primarily expected to be in the form of capture during fish relocation activities.

For each of the Chinook salmon DPSs, NMFS expects no more than 498 juveniles will be captured annually, of which 15 will be injured and 15 will be killed. NMFS expects no more than 576 juvenile California Central Valley DPS steelhead will be annually captured, of which 17 will be injured and 17 will be killed. Given the in-water work windows and other impact and avoidance measures, as well as the limited numbers of green sturgeon within the action area, no more than 6 green sturgeon are expected to be captured annually, of which no more than 1 would be injured and no more than 1 would be killed. If the annual estimates of take per species described is exceeded by more than 10 percent in a single year, or if exceeded by any amount in three consecutive years, the proposed action will be considered to have exceeded anticipated take levels.

2.9.2 Effect of the Take

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

2.9.3 Reasonable and Prudent Measures

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

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead DPS, and Southern DPS of North American green sturgeon:

1. Measures shall be taken to minimize the amount or extent of incidental take of listed salmonids and green sturgeon resulting from the placement of structures or materials in the wetted channel, dewatering of the channel, and the capture and relocation of fish.

2. Measures shall be taken to ensure that individual restoration projects authorized annually through the Program will minimize take of listed salmonids and green sturgeon, will monitor and report take of listed salmonids and green sturgeon, and where feasible, obtain specific project information to better assess the effects and benefits of salmonid restoration projects authorized through the Program.

3. Measures shall be taken to handle or dispose of any individual Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead DPS, or Southern DPS of North American green sturgeon actually killed.

2.9.4 Terms and Conditions

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

1. The following terms and conditions implement Reasonable and Prudent Measure No. 1, which states that measures shall be taken to minimize the amount or extent of incidental take of listed salmonids and green sturgeon resulting from the placement of structures or materials in the wetted channel, dewatering of the channel, and the capture and relocation of fish:

    a. If the annual estimates of take per species described above is exceeded by 10 percent or more in any single year, or if exceeded by any amount in three consecutive years, NOAA RC, the Corps, and USFWS will develop an adaptive management plan in coordination with NMFS to incorporate additional minimization measures in project plans as needed. At a minimum, an adaptive management plan will consider reducing the total number of concurrent projects covered by the Program to a number fewer than that which would result in the expected level of take per species described above[2].

    b. Any injuries or mortality from a project-specific fish relocation site that exceeds three percent of captured fish for any listed species shall be reported to the nearest NMFS office within 48 hours and relocation activities shall cease until a NOAA RC biologist is on site to supervise the remainder of relocation activities.

2. The following terms and conditions implement Reasonable and Prudent Measure No. 2, which states that measures shall be taken to ensure that individual restoration projects authorized annually through the Program will minimize take of listed salmonids and green sturgeon, will monitor and report take of listed salmonids and green sturgeon, and where feasible, obtain specific project information to better assess the effects and benefits of salmonid restoration projects authorized through the Program.

    a. In order to monitor the impact and track incidental take of listed salmonids, the NOAA RC which is responsible for administration and oversite of the Program, must annually submit to NMFS a report of the previous year's restoration activities. The annual report shall include a summary of the specific type and

[2] If take in a single year is exceeded by 15 percent, an adaptive management plan would consider reducing the number of concurrent projects covered by the Program to 51 projects (15 percent fewer than 60). If take is exceeded in three consecutive years, such that the average exceedance for the three years was 7 percent, an adaptive management plan would consider reducing the number of concurrent projects covered by the Program to 55 projects (7 percent fewer than 60, rounded up).

location of each project, stratified by individual project, 5th field HUC and affected species and ESU/DPS.:

- Summary narrative detailing fish relocation activities, including the number and species of fish relocated and the number and species injured or killed. Any capture, injury, or mortality of adult salmonids or half-pounder steelhead will be noted in the monitoring data and report. Any injuries or mortality from a fish relocation site that exceeds 3 percent of the affected listed species shall have an explanation describing why.

- The total number and species of fish captured and the total number and species injured or killed during the previous three years of Program implementation. If the annual estimates of take per species is exceeded by more than 10 percent in a single year, or if exceeded by any amount in three consecutive years, the annual report will also outline steps necessary to develop an adaptive management plan for the Program.

- The number and type of instream structures implemented within the stream channel.

- The length of streambank (feet) stabilized or planted with riparian species.

- The number of culverts replaced or repaired, including the number of miles of restored access to unoccupied salmonid habitat.

- The distance (feet) of aquatic habitat disturbed at each project site.

This report shall be submitted annually by March 1 to the NMFS Central Valley Office:

National Marine Fisheries Service
Central Valley Office Supervisor
650 Capitol Mall, Suite 5-100
Sacramento, California 95814

3. The following terms and conditions implement Reasonable and Prudent Measure No. 3, which states that measures shall be taken to handle or dispose of any individual Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead DPS, or Southern DPS of North American green sturgeon actually killed.

   a. All steelhead, Chinook salmon, and green sturgeon mortalities must be retained, placed in an appropriately sized whirl-pak or zip-lock bag, labeled with the date and time of collection, fork length, location of capture, and frozen as soon as possible. Frozen samples must be retained until specific instructions are provided by NMFS.

2.10 Conservation Recommendations

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

NMFS has no conservation recommendation for this proposed action.

2.11 Reinitiation of Consultation

This concludes formal consultation for the NOAA Restoration Center's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California.

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

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

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

This analysis is based, in part, on the EFH assessment provided by the NOAA Restoration Center, the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers, and descriptions of EFH for Pacific Coast salmon (Pacific Fishery Management Council [PFMC] 2014), and Pacific Coast groundfish (PFMC 2005), and contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

Pacific coast salmon, and Pacific groundfish, may be adversely affected by the proposed action. Specific habitats identified in PFMC (2014) for Pacific coast salmon include Habitat Areas of Particular Concern (HAPCs), identified as: 1) complex channels and floodplain habitats; 2) thermal refugia; and 3) spawning habitat. HAPCs for salmon also include all waters and substrates and associated biological communities falling within the habitat areas defined above. Essentially, all Chinook habitat located within the proposed action area are considered HAPC as defined in PFMC (2014). These HAPC EFH areas include current and historical distribution of salmon in California obtained from Calfish (2012) and NMFS (2005) (as cited in PFMC 2014). Estuaries in the action area that may be adversely affected for Pacific groundfish (PFMC 2005), are those existing in the western-most region of the Delta. This estuarine area is potential habitat for eelgrass (*Zostera marina*), which is also designated as EFH-HAPCs for groundfish.

Restoration activities typically occur in watersheds and estuaries subjected to significant levels perturbation that have reduced the quality and quantity of instream habitat available for native anadromous fish. Types of permitted projects covered by the Program include: instream habitat improvement, fish passage improvement (including construction of new fish ladders/fishways and maintenance of existing ladders), bank restoration, riparian restoration, upslope restoration, and stream or estuary restoration. The majority of the actions considered in the accompanying opinion follow those described in: (1) California Department of Fish and Game's (CDFG) *California Salmonid Stream Habitat Restoration Manual, Third Edition, Volume II* with three new chapters *(Part IX: Fish Passage Evaluation at Stream Crossings, Part X: Upslope Assessment and Restoration Practices, and Part XI: Riparian Habitat Restoration*) added in 2003 and 2004 (Flosi et al. 2010), (2) NMFS' *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2000), and (3) NMFS' *Fish Screening Criteria for Anadromous Salmonids* (NMFS 1997).

3.2 Adverse Effects on Essential Fish Habitat

NMFS has evaluated the proposed project for potential adverse effects to EFH pursuant to Section 305(b)(2) of the Magnusson-Stevens Fishery Conservation and Management Act. As described and analyzed in the accompanying opinion, NMFS anticipates some short-term sediment impacts will occur downstream of the project locations and outward from banks of estuarine areas. Increased fine sediment could further degrade already degraded habitat conditions in many of the proposed project locations. Flowing water may be temporarily diverted around some projects (salmon EFH), resulting in short-term loss of habitat space and short-term reductions in macroinvertebrates (food for EFH species).

The duration and magnitude of direct effects to EFH associated with implementation of individual restoration projects will be significantly minimized due to the multiple minimization measures utilized during project execution. Short-term adverse effects that occur will be offset by long-term beneficial effects to the function and value of EFH.

3.3 Essential Fish Habitat Conservation Recommendations

Section 305(b)(4)(A) of the Magnusson-Stevens Fishery Conservation and Management Act authorizes NMFS to provide EFH Conservation Recommendations that will minimize adverse effects of an activity on EFH. Although short-term potential adverse effects anticipated as a result of project activities, the proposed minimization and avoidance measures, and terms and conditions in the accompanying opinion are sufficient to avoid, minimize and/or mitigate for the anticipated affects. Therefore, no EFH additional Conservation Recommendations are necessary at this time to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH.

3.4 Supplemental Consultation

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

4. FISH AND WILDLIFE COORDINATION ACT

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

The following recommendations apply to the proposed action:

- At any project site within the Action Area that experiences foot traffic, the project applicant should post interpretive signs describing the presence of listed fish and/or critical habitat as well as highlighting their ecological and cultural value.

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

This concludes the FWCA portion of this consultation.

5. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The 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.

5.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the NOAA Restoration Center, U.S. Fish and Wildlife Service, and the U.S. Army Corps of Engineers. Individual copies of this opinion were provided to the NOAA RC, USFWS, and the Corps. This opinion will be posted on the Public Consultation Tracking System website. The format and naming adheres to conventional standards for style.

5.2 Integrity

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

5.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

July 3, 2013

In response, refer to:
2012-02390

Susan M. Fry
Area Manager
U.S. Department of the Interior
Bureau of Reclamation, Mid-Pacific Region
Bay-Delta Office
801 I Street, Suite 140
Sacramento, California 95814-2536

Lieutenant Colonel John K. Baker
U.S. Department of the Army
San Francisco District, Corps of Engineers
1455 Market Street
San Francisco, California 94103-1398

Dear Ms. Fry and Colonel Baker:

This document transmits NOAA's National Marine Fisheries Service's (NMFS) biological opinion (Enclosure 1) based on our review of the proposed 30-year Suisun Marsh Habitat Management, Preservation, and Restoration Plan (SMP) in Solano County, California. The Bureau of Reclamation (Reclamation) will be funding, in part, some maintenance activities and infrastructure improvements, through the Suisun Marsh Preservation Agreement Implementation Fund and the Joint-Use Facility Improvements program. The U.S. Army Corps of Engineers (Corps) will be permitting all field activities proposed in the SMP through either Regional General Permit 3 or a letter of permission (Corps File No. 242156N). NMFS has examined the effects of the proposed SMP on the following listed species (Evolutionarily Significant Units [ESU] or Distinct Population Segments [DPS]) present within the action area, in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*):

Sacramento River winter-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
endangered (70 FR 37160; June 28, 2005)
critical habitat (58 FR 33212; June 16, 1993);
Central Valley spring-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
threatened (70 FR 37160; June 28, 2005);
Central California Coast steelhead DPS (*Oncorhynchus mykiss*)
threatened (71 FR 834; January 5, 2006);
Central Valley steelhead DPS (*Oncorhynchus mykiss*)
threatened (71 FR 834; January 5, 2006); and

North American green sturgeon southern DPS (*Acipenser medirostris*)
threatened (71 FR 17757; April 7, 2006)
critical habitat (74 FR 52300; October 9, 2009)

Based on the best available information, the biological opinion concludes that the proposed project is not likely to jeopardize the continued existence of these species or adversely modify designated critical habitat. However, NMFS believes the action is likely to result in take of listed species. An incidental take statement is included with the biological opinion.

Although both Reclamation and Corps are action agencies for this consultation, not all of the activities undertaken in the SMP have a nexus to Reclamation. However, all of the field activities undertaken during implementation of the SMP, including operation and maintenance of managed Suisun Marsh wetland structures, maintenance dredging actions, and wetland restoration, will require authorization from the Corps through either Regional General Permit (RGP) 3 or a letter of permission (LOP). The Corps will retain a Federal nexus for activities undertaken through the SMP so that consultation can be reinitiated, if necessary. The incidental take statement includes non-discretionary terms and conditions for the Corps that are expected to further reduce incidental take of listed anadromous salmonids and green sturgeon in Suisun Marsh.

Additionally, NMFS has evaluated the 30-year SMP for potential adverse effects to Essential Fish Habitat (EFH) pursuant to section 305(b)(2) of the Magnuson-Stevens Fisheries Conservation and Management Act (Magnuson-Stevens Act). Section 305(b)(4)(A) of the Magnuson-Stevens Act authorizes NMFS to provide EFH Conservation Recommendations that will minimize adverse effects of an activity on EFH. Based on our review, NMFS concludes that implementation of the SMP, re-issuance of RGP 3, and issuance of an LOP for related maintenance dredging activities will adversely affect the EFH of various life stages of species managed under the Pacific Groundfish Fishery Management Plan (starry flounder *Platichthys stellatus*), the Pacific Coast Salmon Fishery Management Plan (Chinook salmon), and the Coastal Pelagics Fishery Management Plan (northern anchovy *Engraulis mordax*). Therefore, NMFS has provided EFH Conservation Recommendations in Enclosure 2.

Please note that as lead Federal agency, Reclamation is required to provide a detailed written response to NMFS' EFH Conservation Recommendations within 30 days (Magnuson-Stevens Act (305(b)(4)(B) and 50 CFR 600.920 (k)). The response must include a description of measures adopted by Reclamation for avoiding, mitigating, or offsetting the impact of the project on EFH. If the response is inconsistent with the EFH Conservation Recommendations, the response must explain the reasons for not following the recommendations, including a scientific justification for any disagreement with the agency over the anticipated effects of the proposed action and the measures needed to avoid, mitigate, or offset such effects.

Our practice is to post biological opinions to the NMFS Southwest Region website (http://swr.nmfs.noaa.gov/) 15 business days following transmittal of the opinion to the action agency. We post opinions to our website to increase transparency and provide interested parties an efficient way of obtaining the documents.

If you have questions concerning this consultation, please contact Daniel Logan at (707) 575-6053 or by electronic mail at dan.logan@noaa.gov.

Sincerely,

For Chr E Yu

William W. Stelle, Jr.
Acting Regional Administrator

Enclosures (2)
1. Biological Opinion
2. Essential Fish Habitat Conservation Recommendations

cc: Chris Yates, NMFS, Long Beach
Dave Wickens, US Army Corps of Engineers Regulatory, San Francisco
Cay Goude, US Fish and Wildlife Service, Sacramento
Andy Raabe, US Fish and Wildlife Service, Sacramento
Dean Messer, California Department of Water Resources, West Sacramento
Katie Shulte Joung, California Department of Water Resources, West Sacramento
James Starr, California Department of Fish and Wildlife, Stockton
Steve Chappell, Suisun Resource Conservation District, Suisun City
Jolanta Uchman, San Francisco Regional Water Quality Control Board, Oakland
Jessica Davenport, San Francisco Bay Conservation and Development Commission, San Francisco.
Administrative File: 151422SWR2012SR00277

Enclosure 1

BIOLOGICAL OPINION

ACTION AGENCY:	U.S. Bureau of Reclamation, Mid-Pacific Region U.S. Army Corps of Engineers, San Francisco District
ACTION:	Suisun Marsh Long-Term Habitat Management, Preservation, and Restoration Plan
CONSULTATION CONDUCTED BY:	National Marine Fisheries Service, Southwest Region
TRACKING NUMBER:	2012-2390
DATE ISSUED:	**July 3, 2013**

I. CONSULTATION HISTORY

NOAA's National Marine Fisheries Service (NMFS) staff attended a January 7, 2008, meeting of the Suisun Marsh Plan Regulatory Group with representatives from the Corps of Engineers (Corps), Bureau of Reclamation (Reclamation), U.S. Fish and Wildlife Service (USFWS), San Francisco Bay Conservation and Development Commission, State Water Resources Control Board, and Suisun Resource Conservation District (SRCD). The proposed Suisun Marsh Long-Term Plan was presented by the consultant team and there was an initial discussion of environmental issues.

NMFS staff attended a November 4, 2009, meeting of the Suisun Marsh Plan Regulatory Group. The agencies discussed the development of environmental documents for compliance with the National Environmental Policy Act (NEPA) and possible approaches for compliance with Endangered Species Act (ESA). The USFWS indicated a programmatic biological opinion may be appropriate for their listed species due to the need for design review of each future tidal marsh restoration project.

NMFS staff participated in March 16, 2010, meeting of the Suisun Marsh Plan Regulatory Group. SRCD distributed a draft of their proposal for exterior levee maintenance. There was extensive discussion regarding the dredging of sediments from tidal sloughs for the purpose of maintaining exterior levees. NMFS reviewed the written description of the exterior levee maintenance program and requested on March 30, 2010, that the document include additional information regarding the frequency and locations of future dredging sites.

At the April 22, 2010, meeting of the Suisun Marsh Plan Regulatory Group, agency representatives discussed the status of various environmental documents under preparation for the Suisun Marsh Long-Term Plan. For the section 7 consultation with NMFS, the group considered whether the Corps, Reclamation, or USFWS should be the Federal action agency. NMFS was informed that a consultant has been selected for preparation of a biological assessment. Reclamation suggested the fisheries effects section of the administrative draft EIS/EIR be submitted to NMFS for review.

During a brief telephone conference call on December 16, 2010, representatives of the Suisun Marsh Plan Regulatory Group discussed the status of the NEPA documents and plan development.

The Suisun Marsh Plan Regulatory Group met on January 11, 2012, to discuss the preparation of a biological assessment for the Section 7 consultation with NMFS and USFWS. The Corps indicated that they will be issuing a 10-year Letter of Permission (LOP) or a 10-year Individual Permit for the dredging component of the program. Other routine maintenance activities within the marsh will be permitted through a 5-year Regional General Permit (RGP). The NEPA document for the Long-Term Plan is for 30 years. USFWS indicated they would like to issue a 30-year programmatic biological opinion. The agencies requested NMFS also consider the assessment of a 30-year plan in the biological opinion.

On June 7, 2012, Reclamation mailed to NMFS a request for initiation of consultation for the Suisun Marsh Habitat Management, Preservation, and Restoration Plan (SMP), a comprehensive 30-year plan designed to address the various conflicts regarding the of resources within much of Suisun Marsh. Included with the June 7 letter was a biological assessment, an essential fish habitat (EFH) assessment, and various appendixes. Also, Reclamation provided DVDs with electronic copies of the various assessments, and the final environmental impact statement for the project.

On May 15, 2013, representatives with NMFS, Corps and Reclamation discussed the roles of Reclamation and the Corps over the 30-term of the SMP. On May 30, 2013, NMFS provided a draft project description to USFWS, Corps, Reclamation, CDFW, and SRCD for review and comment; on June 11, 2013, NMFS received comments back on the draft project description from those agencies.

This biological opinion is based on information provided to NMFS with Reclamation's request for formal consultation dated June 7, 2012. Additional information has been provided by the Corps and SRCD. NMFS considered other sources of scientific and commercial information including journal articles, technical reports, and information received from Reclamation and the applicant through June 20, 2013.

II. DESCRIPTION OF THE PROPOSED ACTION

A. Action Area Overview

The action area encompasses Suisun Marsh (Figure 1) in Solano County, California. Located downstream of the Sacramento–San Joaquin Delta, Suisun Marsh is a mosaic of freshwater, brackish, estuarine, and upland habitats. Suisun Marsh is the largest contiguous brackish marsh remaining on the Pacific Coast of the United States (Meng and Matern 2001), and it represents approximately 12 percent of California's wetland habitat. It is bounded to the west, north, and east by hills, and to the south by Suisun, Grizzly, and Honker bays. Montezuma Slough, the largest slough in the action area, runs from east to west between the Sacramento-San Joaquin Delta and Suisun Bay. Major bodies of water draining to Montezuma Slough include Little Honker Bay, and Denverton and Nurse sloughs.

The second largest slough in the action area is Suisun Slough, which essentially splits the marsh into eastern and western portions. Tributaries to Suisun Slough include Cordelia and Goodyear Sloughs, and several small dead-end sloughs. The marsh includes approximately 116,000 acres, of which 52,000 acres are privately or publicly owned managed wetlands. Of the remaining 64,000 acres, most are bays, sloughs, and upland grasslands. Approximately 6,300 acres are unmanaged tidal wetlands and 2,025 acres are permanently flooded wetlands. Networks of tidal sloughs, principally tributaries of Suisun and Montezuma Sloughs, crisscross the marsh. A system of levees encloses about 90 percent of the historic marsh, separating managed wetlands from tidal sloughs, and sometimes subdividing wetland parcels to facilitate management objectives. Levees range from 4 to 8 feet above ground, and most of the wetlands are at or below mean tide elevation. Water is diverted from tidal sloughs into managed wetlands at high tides. At low tides, water drains from managed wetlands to tidal sloughs through outlet structures throughout the marsh. These water diversion intakes and drains are described in detail in the SMP biological assessment (Reclamation 2012).

Management of diked wetland parcels is focused on providing habitat and conditions conducive to the production of specific vegetative forage for targeted waterfowl species, and on the operations of waterfowl hunting clubs. Over 150 private landowners manage their individual parcels according to management plans prepared by the Soil Conservation Service and the SRCD. Private landowners coordinate their activities under the direction of SRCD. CDFW manages more than 14,500 acres within the marsh.

B. Proposed Actions

The SMP addresses user conflicts in Suisun Marsh with a multi-stakeholder approach to the restoration of tidal wetlands and the management of managed wetlands. The SMP includes both tidal restoration activities, and managed wetland operations and maintenance activities to be permitted by the Corps under a Regional General Permit or Letter of Permission. Reclamation will provide cost-share funding for operation and maintenance of the water monitoring and management facilities owned and operated by California Department of Water Resources (DWR) in the Suisun Marsh in accordance with the Suisun Marsh Preservation Agreement. Reclamation will also provide cost-share funding for the Preservation Agreement Implementation Fund that will provide funding for various managed wetland enhancement actions. Table 1 describes the various agencies involved with the Suisun Marsh Plan.

The Corps proposes to re-issue RGP 3 at five year intervals for 30 years beginning in 2013. RGP 3 will authorize 29 types of maintenance activities within Suisun Marsh. Most maintenance actions authorized with RGP 3 are associated with the repair and maintenance of existing levees and replacement of water control structures. Table 2 presents a complete list of repair and maintenance activities to be included in RGP 3. In addition to maintenance activities, RGP 3 will authorize installation of brush boxes as alternative bank protection on exterior levees.

With the issuance of a Letter of Permission (LOP), the Corps proposes to authorize dredging for levee maintenance and fish screen maintenance in the Suisun Marsh action area. The LOP will be for a 10-year term and the Corps will re-issue the LOP at 10 year intervals for 30 years beginning in 2013. The Corps will issue RGP 3 and LOP pursuant to their authorities under section 404 of the Clean Water Act.

The proposed actions in Suisun Marsh are presented below as three components: (1) operation and maintenance of managed wetland structures, (2) maintenance dredging actions, and (3) wetland restoration. Although RGP 3 only authorizes maintenance of managed wetland facilities, maintenance at water control facilities (*i.e.*, tidal gates and culverts) allows for subsequent operations. As such, operations are interdependent and interrelated to RGP 3 maintenance activities, and operation of water control facilities are considered in this biological opinion.

Under the SMP, both tidal restoration and managed wetland activities will proceed concurrently. Beginning in year 11 of the 30-year program, managed wetland activities under RGP 3 and the LOP will only be permitted by the Corps if at least one third of the total restoration activities are implemented. Beginning in year 21 of the program, managed wetland activities under RGP 3 and the LOP will only be permitted by the Corps if at least two thirds of the total restoration activities are implemented. Assessment of program implementation and re-issuance of Corps authorizations in 10-year increments will ensure that restoration efforts compensate for impacts and contribute toward tidal marsh habitat restoration throughout the plan implementation.

1. <u>Operation and Maintenance of Managed Suisun Marsh Wetland Structures</u>

Over 150 private landowners throughout Suisun Marsh manage their individual wetland parcels according to management plans prepared by the Soil Conservation Service and the SRCD. These management plans target the creation of seasonal habitat for waterfowl and recreational hunting opportunities. Private landowners coordinate their activities under the direction of SRCD. On parcels owned by the State of California, CDFW manages more than 14,500 acres within the marsh, primarily wetlands for waterfowl.

Wetland management involves diversion and subsequent draining of tidal waters into and out of managed wetlands. Managed wetlands are separated from tidal sloughs and bays by external levees and from adjacent managed wetlands by internal levees. CDFW and private landowners use various structures, such as levees, ditches, water control facilities, grading, pumps, and fish screens to manipulate the timing, duration, and depth of flooding to meet wetland management objectives. Waterfowl habitat and forage studies have concluded that plant communities are controlled by the depth and duration of soil inundations, and by salinity levels in the root zones. A number of factors, including location in the marsh, water control facilities, and water year type, drive the operations schedule for managed wetlands in Suisun Marsh. Most wetland managers in the Suisun Marsh begin flooding their wetlands in late September and October in preparation for the fall migration of waterfowl. Whenever possible, wetland managers use gravity flow to fill and drain their wetlands.

Gravity flow can be used because most of the wetlands are at or below mean tide elevation. Consequently, the wetlands are filled during flood tides when the water can flow through the water control structures into the managed wetlands. Water is drained during ebb tides when water can flow out of the managed wetlands. During initial flood-up, the inlet gates are opened and the drain gates remain closed to allow the managed wetlands to fill to an average depth of eight to twelve inches. Thus, diversions may operate for less than 12 hours a day (during the two high tide cycles) and the volume and velocity of diversions vary greatly based upon the location and diameter of the intake, and the head pressure created by the high tide stage.

The SRCD provided estimates of the volume of water required during the initial fall flood-up. Most wetland managers in Suisun Marsh flood their wetlands to an average depth of 8 to 12 inches in late September and October in preparation for the fall waterfowl migration. The SRCD estimates the total flooded wetland acreage is about 40,000 acres with average depth of about 1 foot, for a total diversion of 40,000 acre-feet (Reclamation 2012). However, this may be an overestimate of the volume diverted for two reasons. First, many areas within managed wetlands exhibit wetland characteristics, but do not flood, or do not flood to the same depth assumed in the model, and second, some managed wetlands receive treated wastewater for a portion of their water use. In mid-October to late January, water is circulated through wetlands by diverting through adjacent sloughs on flood tides and draining at ebb tides. Following waterfowl season, managed wetlands are drained in February and spring flood-up (leach cycles and irrigations) of the managed wetlands begins. During this period wetlands are rapidly drained and flooded to half the fall water level to remove surface salts from the wetland soils (one to two leach cycles). Water remaining in the wetlands in June and July is drained to allow vegetative growth and routine maintenance activities during the summer work season. All water diversions for wetland operations will follow seasonal and operational restrictions described in Chapter 12 of the SMP Biological Assessment (Reclamation 2012).

After initial flood-up and during waterfowl hunting season (mid-October to late January), water is circulated through wetlands by diverting from adjacent sloughs on flood tides, and draining at ebb tides. Compared to the initial flood-up period, relatively small amounts of water are exchanged between the sloughs and the wetlands during circulation. Water is moved through the managed wetlands to maintain water quality and depth. Although managed wetlands are not typically drained below about eight inches during this period, properties that start to generate poor water quality conditions or that are contributing to high mosquito production may require increased circulation or complete drainage in October. These conditions depend on the weather during the fall season and requirements of the Solano County Mosquito Abatement District.

Managed wetlands are drained in February following waterfowl season, and spring flood-up begins in February and March. Spring management requires drainage of the managed wetland and re-flooding to half of the fall water depth. Drainage capabilities, spring weather, and Delta outflow dictate when most wetlands can complete draining and re-flooding. Subsequent to spring flood-up, wetlands will undergo one to two leach cycles, consisting of rapid draining and flooding to half the fall water level, to remove surface salts from the wetland soils. Once the spring leach cycles are complete, water is only diverted to maintain water level and provide good water quality in the wetlands.

In 1993 and 1994, section 7 consultations between Reclamation, Corps, USFWS, and NMFS, resulted in the establishment of curtailments and restrictions on most unscreened diversions in sloughs known to support juvenile salmonids or delta smelt. These diversion curtailments have been in effect since 1995 and the measures are now incorporated as conditions in the current RGP 3 issued by the Corps. The Corps has proposed to keep these operational restrictions as special conditions in the re-issuance of RGP 3. For the installation of new and replacement of existing water control structures, SRCD strives to consolidate and/or equip intakes with state-of-the-art fish screens when practicable and as funding allows. Intakes that present the highest risk of entrainment to salmonid smolts are given the highest priority, including intakes located on Montezuma, Suisun, and Cordelia Sloughs.

There are 29 maintenance activities authorized in RGP 3 (Table 2). Reclamation and the Corps evaluated the potential maintenance project-related effects and determined that about half of the proposed actions will have no effect on ESA-listed anadromous salmonids, green sturgeon or designated critical habitat (see below). For maintenance activities that may affect ESA-listed anadromous salmonids, green sturgeon, and designated critical habitat, Reclamation and the Corps have proposed best management practices to further reduce potential effects from maintenance activities (Table 3).

Reclamation has determined 16 of the 29 proposed maintenance activities will have no effect on ESA-listed anadromous fish or critical habitat. These activities take place entirely inside the exterior levees of the managed wetlands. These activities are listed below. Further detail is available in the SMP biological assessment (Reclamation 2012).

- Repair existing interior levees.
- Core existing interior levees.
- Grade pond bottoms for water circulation.
- Create pond bottom spreader V-ditches.
- Repair existing interior water control structures.
- Replace pipe for existing interior water control structures or install new interior water control structures.
- Install new blinds and relocate, replace, or remove existing blinds.
- Disc managed wetlands.
- Install drain pumps and platforms.
- Replace riprap on interior levees.
- Remove floating debris from pipes, trash racks, and other structures.
- Install alternative bank protection such as brush boxes, biotechnical wave dissipaters, and vegetation on interior levees.
- Construct cofferdams in managed wetlands.
- Construct new interior ditch; clear existing interior ditches.
- Placement of new riprap on interior levees.

- Constructing new interior levees for improved water control and habitat management in managed wetlands.

Reclamation has determined that 14 of the 29 proposed maintenance activities for managed wetlands are likely to affect or adversely affect ESA-listed anadromous fish or designated critical habitat. Reclamation and the Corps have requested consultation on these activities. Activities and associated best management practices are listed in Table 3. Further detail is available in the SMP biological assessment (Reclamation 2012).

2. <u>Maintenance Dredging Actions</u>

Since 1994, the primary source of material for exterior levee maintenance has come from adjacent managed wetlands or beneficial reuse of suitable imported materials from outside of the managed marsh. However, the anticipated need for levee maintenance over the next 30 years will not be met with these sources. To meet this need for materials to place on levees, landowners and land managers (*i.e.*, CDFW, DWR) may dredge materials adjacent to levee maintenance sites from neighboring tidal sloughs, bays, and dredger cuts using a long-reach excavator or clamshell dredge. To clear sediment accumulations from water control structures, fish screens, and the Suisun Marsh Salinity Control Structure, dredging may occur adjacent to these facilities throughout the marsh.

The Corps and SRCD have proposed to limit dredging for levee maintenance to 2.1 cubic yards per linear foot of channel adjacent to exterior levees on each property or the length of dredger cut. Since dredging from sites exterior to perimeter levees has not occurred since 1994, it is difficult to estimate the total amount of dredging that may occur under RGP 3. The Corps and SRCD propose an annual maximum limit of 100,000 cubic yards of dredging, spread throughout the action area (Table 4). Dredging the maximum annual amount of 100,000 cubic yards will result in impacts to approximately 66 acres within Suisun Marsh. However, based on current needs and feasibility analysis, SRCD anticipates no more than 30,000 cubic yards of dredging per year for a footprint of 19.7 acres.

This dredging will be limited to the period between August and November. To contain runoff from the levee as dredged materials are place on the crown, berms will be constructed on the exterior-side of the levee. Source materials for levee maintenance may also be obtained by dredging from areas interior to perimeter levees (*i.e.*, diked managed wetlands) or from imported materials. Levee maintenance materials obtained by dredging from neighboring sloughs, bays, or dredger cuts will be authorized with a 10-year Letter of Permission from the Corps. Levee maintenance materials obtained by dredging from within diked managed wetlands or imported materials will be authorized by RGP 3.

3. <u>Wetland Restoration</u>

The SMP proposes to restore 5,000 to 7,000 acres of tidal wetlands over the 30-year planning period. Although the exact location, size, timing, and design of each individual tidal restoration action are unknown at this time, the SMP includes guidelines and targets for restoration actions (Tables 5 and 6). The selection of tidal restoration sites will take into consideration several factors, including land available for purchase, physical and biological site characteristics, and contribution to restoration acreage goals. Restoration site selection will include Principal Agencies identified in Table 1. An Adaptive Management Advisory Team has been established for the SMP and this group will work collaboratively with others to select the most biologically appropriate, cost-effective, and SMP-compatible restoration site.

Lands suitable for restoration of tidal wetlands will always be purchased from willing sellers by the project proponent. As restoration opportunities present themselves, factors to be considered are presented in Table 5. Some of the most important physical considerations are location and proximity to existing tidal habitats, site elevation, infrastructure, flood liability of adjacent lands, and costs of required levee improvements and long-term maintenance. Funding sources and projects targeting specific species biological needs also will help focus what sites to pursue. One overarching goal of restoration is to create a diverse mosaic of interconnected habitat types; therefore, the type of restoration that has already occurred will be considered. To ensure that restoration sites are spread geographically throughout the marsh, the SMP has established total restoration target percentages by region (Table 6).

In addition to the above guidelines, future permitting by the Corps is contingent on achieving specific tidal restoration targets. Beginning in year 11 of the 30-year program, managed wetland activities under RGP 3 and the LOP will only be permitted by the Corps if at least 1,650 acres (one third of 5,000 acres) restoration activities are implemented. Beginning in year 21 of the program, activities under RGP 3 and the LOP will only be permitted by the Corps if at least 3,300 acres (two thirds of 5,000 acres) of the total restoration activities are implemented. These restoration actions are intended to compensate for the effects on listed fish, bird and mammal species associated with SMP maintenance activities and to contribute to recovery of listed species.

Once a site has been acquired from a willing seller, the project proponent may take from 1 or more years to undertake necessary land management activities to prepare the site for restoration. All of these preparation actions will be completed behind exterior levees and isolated from tidal sloughs to avoid potential effects to ESA-listed fish and designated critical habitat. Each restoration site will be designed to accomplish specific environmental goals by restoring historical conditions. When construction and other site preparation activities are completed, then the proponent will breach the exterior levee to reconnect the site to tidal exchange. Specific breach locations will be based on maximizing ecological benefit and effects to local hydrology. To protect adjacent properties from an increased risk of flooding, existing exterior levees may be upgraded or new exterior levees constructed prior to breaching a levee. Breaching of levees will occur during the summer when listed anadromous salmonids are not present.

4. <u>Reporting</u>

To track progress of restoration and managed wetland activities, annual reports will be submitted to NMFS and other regulatory agencies. Reports will be prepared by Reclamation, SRCD, DWR, and CDFW. In general, reports will include the following information (for full description of reporting see Chapter 2 of the biological assessment [Reclamation 2012]):

- The location, extent and timing of land acquisition for tidal restoration.
- Status of restoration planning for acquired properties.
- Descriptions of the previous years managed wetland activities, including a description of how actual impacts compare to impacts analyzed in the SMP biological assessment.
- Description of monitoring results.
- A summary of how implemented activities compare to SMP goals in terms of habitat types, managed wetland operations, acreage goals, and species composition.

If any report indicates that restoration or managed wetland targets are not being met nor have the potential not to be met, the SMP agencies along with NMFS and USFWS will convene to determine how to proceed to get plan implementation on track.

In addition to the best management practices described above, a full description of all proposed conservation measures are described in Chapter 12 of the biological assessment (Reclamation 2012). All best management practices and conservation measures described in this biological opinion are parts of the proposed action and are intended to avoid or minimize adverse project-related effects to ESA-listed anadromous fish and designated critical habitat. The NMFS regards these conservation measures as integral components of the proposed action and expects that all proposed avoidance and minimization measures will be completed.

D. Description of the Action Area

The action area is defined as all areas affected directly or indirectly by the Federal action and not merely the immediate area involved (50 CFR 402.02). The action area encompasses 116,000 acres in Suisun Marsh (Figure 1), Solano County, California. It is bounded to the west, north, and east by hills, and to the south by Suisun, Grizzly, and Honker bays. Montezuma Slough, the largest slough in the action area, runs from east to west between the Sacramento-San Joaquin Delta and Suisun Bay. Major bodies of water include Montezuma Slough, Suisun Slough, Little Honker Bay, and Denverton and Nurse sloughs. Tributaries to Suisun Slough include Cordelia and Goodyear Sloughs, and several small dead-end sloughs. The 116,000 acres within Suisun Marsh includes 52,000 acres are privately or publicly owned managed wetlands and 64,000 acres of bays, sloughs, and upland grasslands. The action area includes areas that will be affected by RGP 3 and LOP maintenance activities, as well as, SMP tidal wetland restoration actions.

III. ANALYTICAL FRAMEWORK

A. Jeopardy Analysis

In accordance with policy and regulation, the jeopardy analysis in this biological opinion relies on four components: (1) the Status of the Species, which evaluates the Central California Coast (CCC) steelhead DPS, Central Valley (CV) steelhead DPS, southern DPS of North American green sturgeon, winter-run Chinook salmon ESU, and CV spring-run ESU range-wide conditions, the factors responsible for that condition, and the species' likelihood of both survival and recovery; (2) the Environmental Baseline, which evaluates the condition of these listed species in the action area, the factors responsible for that condition, and the relationship of the action area to the likelihood of both survival and recovery of these listed species; (3) the Effects of the Action, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on these species in the action area; and (4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on these species.

The jeopardy determination is made by adding the effects of the proposed Federal action and any Cumulative Effects to the Environmental Baseline and then determining if the resulting changes in species status in the action area are likely to cause an appreciable reduction in the likelihood of both the survival and recovery of these listed species in the wild.

The jeopardy analysis in this biological opinion places an emphasis on the range-wide likelihood of both survival and recovery of these listed species and the role of the action area in the survival and recovery of these listed species. The significance of the effects of the proposed Federal action is considered in this context, taken together with cumulative effects, for purposes of making the jeopardy determination. We use a hierarchical approach that focuses first on whether or not the effects on salmonids and green sturgeon in the action area will impact their respective populations. If the population will be impacted, we assess whether this impact is likely to affect the ability of the population to support the survival and recovery of the DPS or ESU.

B. Adverse Modification Analysis

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02, which was invalidated by *Gifford Pinchot Task Force v. USFWS*, 378 F.3d 1059 (9th Cir. 2004), amended by 387 F.3d 968 (9th Cir. 2004). Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

The adverse modification analysis in this biological opinion relies on four components: (1) the Status of Critical Habitat, which evaluates the range-wide and watershed-wide condition of critical habitat for the affected salmonid and green sturgeon DPSs and ESUs in terms of primary constituent elements (PCEs – sites for spawning, rearing, and migration), and/or essential features, and the factors responsible for that condition, and the resulting conservation value of the critical habitat overall; (2) the Environmental Baseline, which evaluates the condition of critical habitat in the action area, the factors responsible for that condition, and the conservation value of critical habitat in the action area; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the critical habitat in the action area and how that will influence the conservation value of affected critical habitat units; and (4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the critical habitat and how that will influence the conservation value of affected critical habitat units.

For purposes of the adverse modification determination, we add the effects of the proposed Federal action on green sturgeon and winter-run Chinook salmon critical habitat in the action area, and any Cumulative Effects, to the Environmental Baseline and then determine if the resulting changes to the conservation value of critical habitat in the action area are likely to cause an appreciable reduction in the conservation value of critical habitat range-wide. If the proposed action will negatively affect PCEs and/or essential features of critical habitat in the action area we then assess whether or not this reduction will impact the value of the DPS or ESU critical habitat designation as a whole.

C. Use of Best Available Scientific and Commercial Information

To conduct the assessment, NMFS examined an extensive amount of information from a variety of sources. Detailed background information on the biology and status of the listed species and critical habitat has been published in a number of documents including peer reviewed scientific journals, primary reference materials, and governmental and non-governmental reports. Additional information regarding the effects of the project's actions on the listed species in question, their anticipated response to these actions, and the environmental consequences of the actions as a whole was formulated from the aforementioned resources.

A complete administrative record of this consultation is on file in the NMFS Santa Rosa Area Office (Administrative Record Number 151422SWR2012SR00277).

IV. STATUS OF THE SPECIES AND CRITICAL HABITAT

The following listed species and designated critical habitat occur in the action area and may be affected by the proposed project.

Sacramento River winter-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
endangered (70 FR 37160; June 28, 2005)
critical habitat (58 FR 33212; June 16, 1993);
Central Valley spring-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
threatened (70 FR 37160; June 28, 2005);
Central California Coast steelhead DPS (*Oncorhynchus mykiss*)
threatened (71 FR 834; January 5, 2006);
Central Valley steelhead DPS (*Oncorhynchus mykiss*)
threatened (71 FR 834; January 5, 2006); and
North American green sturgeon southern DPS (*Acipenser medirostris*)
threatened (71 FR 17757; April 7, 2006)
critical habitat (74 FR 52300; October 9, 2009).

A. Species Description, Life History, and Status

In this opinion, NMFS assesses four population viability parameters to help us understand the status of CCC steelhead, CV steelhead, CV spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, and southern DPS green sturgeon and their populations' ability to survive and recover. These population viability parameters are: abundance, population growth rate, spatial structure, and diversity (McElhany *et al.* 2000). NMFS has used existing information to determine the general condition of each population and factors responsible for the current status of each DPS or ESU.

We use these population viability parameters as surrogates for numbers, reproduction, and distribution, the criteria found within the regulatory definition of jeopardy (50 CFR 402.02). For example, the first three parameters are used as surrogates for numbers, reproduction, and distribution. We relate the fourth parameter, diversity, to all three regulatory criteria. Numbers, reproduction, and distribution are all affected when genetic or life history variability is lost or constrained. This results in reduced population resilience to environmental variation at local or landscape-level scales.

1. <u>CV Spring-run and Sacramento River Winter-run Chinook Salmon</u>

a. General Life History

Chinook salmon return to freshwater to spawn when they are 3 to 8 years old (Healy 1991). Runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and actual time of spawning (Myers *et al.* 1998). Both winter-run and spring-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. For comparison, fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991). Adult endangered Sacramento River winter-run Chinook salmon enter San Francisco Bay from November through May (Hallock and Fisher 1985), and delay spawning until spring or early summer. Adult threatened Central Valley spring-run Chinook salmon enter the Sacramento-San Joaquin Delta (Delta) beginning in January and enter natal streams from March to July (Myers *et al.* 1998). Central Valley spring-run Chinook salmon adults hold in freshwater over summer and spawn in the fall. Central Valley spring-run Chinook salmon juveniles typically spend a year or more in freshwater before migrating toward the ocean. Adequate instream flows and cool water temperatures are more critical for the survival of Central Valley spring-run Chinook salmon due to over summering by adults and/or juveniles.

Sacramento River winter-run Chinook salmon spawn primarily from mid-April to mid-August, peaking in May and June, in the Sacramento River reach between Keswick Dam and the Red Bluff Diversion Dam. Central Valley spring-run Chinook salmon typically spawn between September and October depending on water temperatures. Chinook salmon generally spawn in waters with moderate gradient and gravel and cobble substrates. Eggs are deposited within the gravel where incubation, hatching, and subsequent emergence take place. The upper preferred water temperature for spawning adult Chinook salmon is 55 ^{o}F (Chambers 1956) to 57 ^{o}F (Reiser and Bjornn 1979). The length of time required for eggs to develop and hatch is dependent on water temperature, and quite variable.

Sacramento River winter-run Chinook salmon fry begin to emerge from the gravel in late June to early July and continue through October (Fisher 1994). Juvenile winter-run Chinook salmon spend 4 to 7 months in freshwater prior to migrating to the ocean as smolts. Central Valley spring-run Chinook salmon fry emerge from November to March and spend about 3 to 15 months in freshwater prior to migrating towards the ocean (Kjelson *et al.* 1981). Post-emergent fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and crustaceans. Chinook fry and parr may spend time rearing within riverine and/or estuarine habitats including natal tributaries, the Sacramento River, non-natal tributaries to the Sacramento River, and the Delta.

Within estuarine habitat, juvenile rearing Chinook salmon movements are generally dictated by tidal cycles, following the rising tide into shallow water habitats from the deeper main channels, and returning to the main channels when the tide recedes (Levings 1982, Levy and Northcote 1982, Healey 1991). Juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels and sloughs (McDonald 1960, Dunford 1975). As juvenile Chinook salmon increase in length, they tend to school in the surface waters of the main and secondary channels and sloughs, following the tides into shallow water habitats to feed (Allen and Hassler 1986). Kjelson *et al.* (1981) reported that juvenile Chinook salmon demonstrated a diel migration pattern, orienting themselves to nearshore cover and structure during the day, but moving into more open, offshore waters at night. The fish also distributed themselves vertically in relation to ambient light. Juvenile Sacramento River winter-run Chinook salmon migrate to the sea after only rearing in freshwater for 4 to 7 months, and occur in the Delta from October through early May (CDFW 1998). Most Central Valley spring-run Chinook salmon smolts are present in the Delta from mid-March through mid-May depending on flow conditions (CDFW 2000).

b. Status of the Sacramento River Winter-Run Chinook Salmon and Critical Habitat

The Sacramento River winter-run Chinook salmon ESU has been completely displaced from its historical spawning habitat by the construction of Shasta and Keswick dams. Approximately, 300 miles of tributary spawning habitat in the upper Sacramento River is now inaccessible to the ESU. Most components of the Sacramento River winter-run Chinook salmon life history (*e.g.*, spawning, incubation, freshwater rearing) have been compromised by the habitat blockage in the upper Sacramento River. The remaining spawning habitat in the upper Sacramento River is artificially maintained by cool water releases from Shasta and Keswick Dams, and the spatial distribution of spawners is largely governed by the water year type and the ability of the Central Valley Project to manage water temperatures in the upper Sacramento River.

Between the time Shasta Dam was built and the Sacramento River winter-run Chinook salmon were listed as endangered, major impacts to the population occurred from warm water releases from Shasta Dam, juvenile and adult passage constraints at the RBDD, water exports in the southern Delta, and entrainment at a large number of unscreened or poorly-screened water diversions. The naturally spawning component of this ESU has exhibited marked improvements in abundance and productivity in the 2000s (CDFW 2008). These increases in abundance are encouraging, relative to the years of critically low abundance of the 1980s and early 1990s; however, returns of several West Coast Chinook salmon and coho salmon stocks were lower than expected in 2007 (NMFS 2008), and stocks remained low through 2009.

A captive broodstock artificial propagation program for Sacramento River winter-run Chinook salmon has operated since the early 1990s as part of recovery actions for this ESU. As many as 150,000 juvenile salmon have been released by this program, but in most cases the number of fish released was in the tens of thousands (Good *et al.* 2005). NMFS reviewed this hatchery program in 2004 and concluded that as much as 10 percent of the natural spawners may be attributable to the program’s support of the population (69 FR 33102). The artificial propagation program has contributed to maintaining diversity through careful use of methods that ensure genetic diversity. If improvements in natural production continue, the artificial propagation program may be discontinued (69 FR 33102).

Critical habitat was designated for the Sacramento River winter-run Chinook salmon on June 16, 1993. Physical and biological features that are essential for the conservation of Sacramento winter-run Chinook salmon, based on the best available information, include: (1) access from the Pacific Ocean to appropriate spawning areas in the upper Sacramento River; (2) the availability of clean gravel for spawning substrate; (3) adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles; (4) water temperatures between 42.5 and 57.5˚F for successful spawning, egg incubation, and fry development; (5) habitat areas and adequate prey that are not contaminated; (6) riparian areas that provides for successful juvenile development and survival; and (7) access downstream so that juveniles can migrate from the spawning grounds to San Francisco Bay and the Pacific Ocean (58 FR 33212).

Designated critical habitat for Sacramento River winter-run Chinook salmon has been degraded from conditions known to support viable salmonid populations. It does not provide the full extent of conservation values necessary for the recovery of the species. In particular, adequate river flows and water temperatures have been impacted by human actions, substantially altering the historical river characteristics in which the Sacramento River winter-run Chinook salmon evolved. Depletion and storage of stream flows behind large dams on the Sacramento River and other tributary streams have drastically altered the natural hydrologic cycles of the Sacramento River and Delta. Alteration of flows results in migration delays, loss of suitable habitat due to dewatering and blockage; stranding of fish from rapid flow fluctuations; entrainment of juveniles into poorly screened or unscreened diversions, and increased water temperatures harmful to salmonids. Other impacts of concern include alteration of stream bank and channel morphology, loss of riparian vegetation, loss of spawning and rearing habitat, fragmentation of habitat, loss of downstream recruitment of spawning gravels, degradation of water quality, and loss of nutrient input.

Several actions have been taken to improve habitat conditions for Sacramento River winter-run Chinook salmon, including: changes in ocean and inland fishing harvest that to increase ocean survival and adult escapement, and implementation of habitat restoration efforts throughout the Central Valley. However, this population remains below established recovery goals and the naturally-spawned component of the ESU is dependent on one extant population in the Sacramento River. Risks to the ESU's genetic diversity, life-history variability, local adaptation, and spatial structure are particularly concerning, as there is only one remaining population (Good *et al.* 2005, 70 FR 37160). The status of Sacramento River winter-run Chinook salmon is little changed since the last status review, and new information available since Good *et al.* (2005) does not appear to suggest a change in extinction risk (Williams *et al.* 2011). On August 15, 2011, NMFS reaffirmed no change to the listing of endangered for the Sacramento River winter-run Chinook salmon ESU (76 FR 50447).

c. Status of the CV Spring-run Chinook Salmon

Historically, the predominant salmon run in the Central Valley was the spring-run Chinook salmon. Extensive construction of dams throughout the Sacramento-San Joaquin basin has reduced the Central Valley spring-run Chinook salmon run to only a small portion of its historical distribution. The Central Valley drainage as a whole is estimated to have supported Central Valley spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFW 1998). The ESU has been reduced to only three naturally-spawning populations that are free of hatchery influence from an estimated 17 historic populations.[1] These three populations (spawning in three tributaries to the Sacramento River - Deer, Mill, and Butte creeks), are in close geographic proximity, increasing the ESU's vulnerability to disease or catastrophic events.

Central Valley spring-run Chinook salmon from the Feather River Hatchery (FRH) were included in the ESU because they are believed by NMFS to be the only population in the ESU that displays early run timing. This early run timing is considered by NMFS to represent an important evolutionary legacy of the spring-run populations that once spawned above Oroville Dam (70 FR 37160). The FRH population is closely related genetically to the natural Feather River population. The FRH's goal is to release five million spring-run Chinook salmon per year. Recent releases have ranged from about one-and-a-half to five million fish, with most releases below five million fish (Good *et al.* 2005).

Several actions have been taken to improve habitat conditions for Central Valley spring-run Chinook salmon, including: habitat restoration efforts in the Central Valley; and changes in freshwater harvest management measures. Although protective measures likely have contributed to recent increases in Central Valley spring-run Chinook salmon abundance, the ESU is still well below levels observed from the 1960s. Threats from hatchery production (*i.e.*, competition for food between naturally-spawned and hatchery fish, run hybridization and genomic homogenization), climatic variation, high temperatures, predation, and water diversions still persist. Because wild Central Valley spring-run Chinook salmon ESU populations are confined to relatively few remaining watersheds and continue to display broad fluctuations in abundance, the Biological Review Team concluded that the ESU is likely to become endangered within the foreseeable future. The most recent status review concludes the status of Central Valley spring-run Chinook salmon ESU has probably deteriorated since the 2005 status review (Williams *et al.* 2011). New information available since Good *et al.* (2005) indicates an increased extinction risk. Based on this information, NMFS has chosen to maintain the threatened listing for this species (76 FR 50447), but recommends reviewing Central Valley spring-run Chinook status again in 2-3 years, (instead of the normal 5 years) if species numbers do not improve (NMFS 2011).

[1] There has also been a small run in Big Chico Creek in recent years (Good *et al.* 2005).

2. CV and CCC Steelhead

a. General Life History

Steelhead are anadromous forms of *O. mykiss*, spending some time in both freshwater and saltwater. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby *et al.* 1996). Although one-time spawners are the great majority, Shapovalov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in California streams. Steelhead young usually rear in freshwater for 1 to 3 years before migrating to the ocean as smolts, but rearing periods of up to 7 years have been reported. Migration to the ocean usually occurs in the spring. Steelhead may remain in the ocean for 1 to 5 years (2 to 3 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). Adult steelhead typically migrate from the ocean to freshwater between December and April, peaking in January and February (Fukushima and Lesh 1998).

Juvenile steelhead migrate as smolts to the ocean from January through May, with peak migration occurring in April and May (Fukushima and Lesh 1998). Barnhart (1986) reported that peak smolt migration occurs in March and April, and steelhead smolts in California typically range in size from 140 to 210 millimeter (mm) (fork length). Steelhead of this size can withstand higher salinities than smaller fish (McCormick 1994), and are more likely to occur for longer periods in tidally influenced estuaries, such as San Francisco Bay. Smolts primarily use estuaries for rearing prior to seawater entry. Smaller steelhead juveniles are likely to avoid salt water and brackish environments, and while they can be acclimated to brackish water, their growth is likely hindered.

Turbidity (*i.e.*, water clarity) also can influence the behavior, distribution and growth of juvenile salmonids (Cordone and Kelley 1961, Sigler *et al.* 1984, Redding *et al.* 1987, Newcombe and McDonald 1991, Newcombe and Jensen 1996). The impacts of turbidity on juvenile salmonids are largely linked to factors such as background turbidity levels and the duration of turbid conditions. Sigler *et al.* (1984) observed avoidance of turbid water by juvenile steelhead and coho when exposed to turbidities as low as 38 NTUs and 22 NTUs, respectively, for a period of 15-17 days. Sigler *et al.* (1984) also observed that fish kept in these turbid conditions had lower growth rates than fish kept in clear water for the same amount of time.

b. Status of CCC Steelhead DPS

Historically, approximately 70 populations[2] of steelhead existed in the CCC steelhead DPS (Spence *et al.* 2008, Spence *et al.* 2012). Many of these populations (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

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

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 on the order of 4,000 fish (NMFS 1997a). Abundance estimates for smaller coastal streams in the DPS indicate low but stable levels with recent estimates for several streams (Lagunitas, Waddell, Scott, San Vincente, Soquel, and Aptos 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). Similar losses in genetic diversity in the Napa River may have resulted from out-of-basin and out-of-DPS releases of steelhead in the Napa River basin in the 1970s and 80s. These transfers included fish from the South Fork Eel River, San Lorenzo River, Mad River, Russian River, and the Sacramento River. In San Francisco Bay streams, reduced population sizes and fragmentation of habitat has likely also led to loss of genetic diversity in these populations. For more detailed information on trends in CCC steelhead abundance, see: Busby *et al.* 1996, NMFS 1997a, Good *et al.* 2005, Spence *et al.* 2008.

CCC steelhead have experienced serious declines in abundance and long-term population trends suggest a negative growth rate. This indicates the DPS may not be viable in the long term. DPS populations that historically provided enough steelhead immigrants to support dependent populations may no longer be able to do so, placing dependent populations at increased risk of extirpation. However, because CCC steelhead remain present in most streams throughout the DPS, roughly approximating the known historical range, CCC steelhead likely possess a resilience that is likely to slow their decline relative to other salmonid DPSs or ESUs in worse condition. In 2005, a status review concluded that steelhead in the CCC steelhead DPS remain "likely to become endangered in the foreseeable future" (Good *et al.* 2005). On January 5, 2006, NMFS issued a final determination that the CCC steelhead DPS is a threatened species, as previously listed (71 FR 834).

A more 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 could be demonstrated to be viable[3] (Spence *et al.* 2008). Research monitoring data from 2008/09 and 2009/10 of adult CCC steelhead returns shows a decline in adults across the range of the DPS compared to the last ten years (Jeffrey Jahn, personal communication, 2010). The most recent status update found that the status of the CCC steelhead DPS remains "likely to become endangered in the foreseeable future" (Williams *et al.* 2011), as new and additional information available since Good *et al.* (2005), does not appear to suggest a change in extinction risk. On December 7, 2011, NMFS chose to maintain the threatened status of the CCC steelhead (76 FR 76386).

[3] Viable populations have a high probability of long-term persistence (> 100 years).

c. Status of the CV Steelhead DPS

Central Valley steelhead historically were well-distributed throughout the Sacramento and San Joaquin rivers (Busby *et al.* 1996). Although it appears Central Valley steelhead remain widely distributed in Sacramento River tributaries, the vast majority of historical spawning areas are currently above impassable dams. At present, all Central Valley steelhead are considered winter-run steelhead (McEwan and Jackson 1996), although there are indications that summer steelhead were present in the Sacramento River system prior to the commencement of large-scale dam construction in the 1940s (IEP Steelhead Project Work Team 1999). McEwan and Jackson (1996) reported that wild steelhead stocks appear to be mostly confined to upper Sacramento River tributaries such as Antelope, Deer, and Mill creeks and the Yuba River. However, naturally spawning populations are also known to occur in Butte Creek, and the upper Sacramento mainstem, Feather, American, Mokelumne, and Stanislaus rivers (CALFED 2000). It is possible that other small populations of naturally spawning steelhead exist in Central Valley streams, but are undetected due to lack of sufficient monitoring and research programs; increases in fisheries monitoring efforts led to the discovery of steelhead populations in streams such as Auburn Ravine and Dry Creek (IEP Steelhead Project Work Team 1999).

Small self-sustaining populations of CV steelhead exist in the Stanislaus, Mokelumne, Calaveras, and other tributaries of the San Joaqiun River (McEwan 2001). On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995 (Demko *et al.* 2000). Incidental catches and observations of steelhead juveniles also have occurred on the Tuolumne and Merced Rivers during fall-run Chinook salmon monitoring activities, indicating that steelhead are widespread, if not abundant, throughout accessible streams and rivers in the Central Valley (Good *et al.* 2005).

Steelhead counts at the Red Bluff Diversion Dam (RBDD) have declined from an average annual count of 11,187 adults for the ten-year period beginning in 1967, to an average annual count 2,202 adults in the 1990's (McEwan and Jackson 1996). Estimates of the adult steelhead population composition in the Sacramento River have also changed over this time period; through most of the 1950’s, Hallock *et al.* (1961) estimated that 88 percent of returning adults were of natural origin, and this estimate declined to 10-30 percent in the 1990’s (McEwan and Jackson 1996). Furthermore, the California Fish and Wildlife Plan estimated a total run size of about 40,000 adults for the entire Central Valley, including San Francisco Bay, in the early 1960s (CDFW 1965). In 1991-92, this run was probably less than 10,000 fish based on dam counts, hatchery returns and past spawning surveys (McEwan and Jackson 1996).

The status of Central Valley steelhead appears to have worsened since the 2005 status review (Good *et al.* 2005), when the biological review team concluded that the DPS was in danger of extinction. New information available since Good *et al.* (2005) indicates an increased extinction risk (Williams *et al.* 2011). Steelhead have been extirpated from most of their historical range in this region. Habitat concerns in this DPS focus on the widespread degradation, destruction, and blockage of freshwater habitat within the region, and water allocation problems. Widespread hatchery production of introduced steelhead within this DPS also raises concerns about the potential ecological interactions between introduced and native stocks. Because the Central Valley steelhead population has been fragmented into smaller isolated tributaries without any large source population, and the remaining habitat continues to be degraded by water diversions, the population remains at an elevated risk for future population declines. Based on this information, NMFS chose to maintain the threatened listing for this species (76 FR 50447), but recommends reviewing Central Valley steelhead status again in 2-3 years, (instead of the normal 5 years) if species numbers do not improve (NMFS 2011).

3. Green Sturgeon

a. General Life History

Green sturgeon is an anadromous, long-lived, and bottom-oriented fish species in the family Acipenseridae. Sturgeon have skeletons composed mostly of cartilage and sturgeon lack scales, instead of possessing five rows of characteristic bony plates on their body called "scutes." On the underside of their flattened snouts are sensory barbels and a siphon-shaped, protrusible, toothless mouth. Large adults may exceed 2 meters in length and 100 kilograms in weight (Moyle 2012). Based on genetic analyses and spawning site fidelity, NMFS determined that North American green sturgeon are comprised of at least two distinct population segments (DPS): a northern DPS consisting of populations originating from coastal watersheds northward of and including the Eel River ("northern DPS green sturgeon"), with spawning confirmed in the Klamath and Rogue river systems; and a southern DPS consisting of populations originating from coastal watersheds south of the Eel River ("southern DPS green sturgeon"), with spawning confirmed in the Sacramento River system (Adams *et al.* 2002).

Green sturgeon are the most marine-oriented species of sturgeon (Moyle 2002). Along the West Coast of North America, they range in nearshore waters from Mexico to the Bering Sea (Adams *et al.* 2002), with a general tendency to head north after their out-migration from freshwater (Lindley *et al.* 2011). While in the ocean, archival tagging indicates that green sturgeon occur in waters between 0 and 200 meters depth, but spend most of their time in waters between 20–80 meters and temperatures of 9.5–16.0°C (Nelson *et al.* 2010, Huff *et al.* 2011). Subadult and adult green sturgeon move between coastal waters and estuaries (Lindley *et al.* 2008, Lindley *et al.* 2011), but relatively little is known about how green sturgeon use these habitats. Lindley *et al.* (2011) report multiple rivers and estuaries are visited by aggregations of green sturgeon in summer months, and larger estuaries (*e.g.*, San Francisco Bay) appear to be particularly important habitat. During the winter months, green sturgeon generally reside in the coastal ocean. Areas north of Vancouver Island are favored overwintering areas, with Queen Charlotte Sound and Hecate Strait likely destinations based on detections of acoustically-tagged green sturgeon (Lindley *et al.* 2008, Nelson *et al.* 2010).

Based on genetic analysis, Israel *et al.* (2009) reported that almost all green sturgeon collected in the San Francisco Bay system were southern DPS. This finding is corroborated by tagging and tracking studies which found that no green sturgeon tagged in the Klamath or Rogue rivers (*i.e.*, Northern DPS) have yet been detected in San Francisco Bay (Lindley *et al.* 2011). However, green sturgeon inhabiting coastal waters adjacent to San Francisco Bay include northern DPS green sturgeon.

Adult southern DPS green sturgeon spawn in the Sacramento River watershed during the spring and early summer months (Moyle *et al.* 1995). Eggs are laid in turbulent areas on the river bottom and settle into the interstitial spaces between cobble and gravel (Adams *et al.* 2007).

Like salmonids, green sturgeon require cool water temperatures for egg and larval development, with optimal temperatures ranging from 11 to 17˚C (Van Eenennaam *et al.* 2005). Eggs hatch after 6–8 days, and larval feeding begins 10–15 days post-hatch. Metamorphosis of larvae into juveniles typically occurs after a minimum of 45 days (post-hatch) when fish have reached 60–80 mm total length (TL). After hatching larvae migrate downstream and metamorphose into juveniles. Juveniles spend their first few years in the Sacramento-San Joaquin Delta (Delta) and San Francisco estuary before entering the marine environment as subadults. Juvenile green sturgeon salvaged at the State and Federal water export facilities in the southern Delta are generally between 200 mm and 400 mm TL (Adams *et al.* 2002) which suggests southern DPS green sturgeon spend several months to a year rearing in freshwater before entering the Delta and San Francisco estuary. Laboratory studies conducted by Allen and Cech (2007) indicated juveniles approximately 6-month old were tolerant of saltwater, but approximately 1.5-year old green sturgeon appeared more capable of successful osmoregulation in salt water.

Subadult green sturgeon spend several years at sea before reaching reproductive maturity and returning to freshwater to spawn for the first time (Nakamoto *et al.* 1995). Little data are available regarding the size and age-at-maturity for the southern DPS green sturgeon, but it is likely similar to that of the northern DPS. Male and female green sturgeon differ in age-at-maturity. Males can mature as young as 14 years and female green sturgeon mature as early as age 16 (Van Eenennaam *et al.* 2006). Adult green sturgeon are believed to spawn every two to five years. Recent telemetry studies by Heublein *et al.* (2009) indicate adults typically enter San Francisco Bay from the ocean and begin their upstream spawning migration between late February and early May. These adults on their way to spawning areas in the upper Sacramento River typically migrate rapidly through the estuary toward their upstream spawning sites. Preliminary results from tagged adult sturgeon suggest travel time from the Golden Gate to Rio Vista in the Delta is generally 1-2 weeks. Post-spawning, Heublein *et al.* (2009) reported tagged southern DPS green sturgeon displayed two outmigration strategies; outmigration from Sacramento River prior to September 1 and outmigration during the onset of fall/winter stream flow increases. The transit time for post-spawning adults through the San Francisco estuary appears to be very similar to their upstream migration (*i.e.*, 1-2 weeks).

During the summer and fall, an unknown proportion of the population of non-spawning adults and subadults enter the San Francisco estuary from the ocean for periods ranging from a few days to 6 months (Lindley *et al.* 2011). Some fish are detected only near the Golden Gate, while others move as far inland as Rio Vista in the Delta. The remainder of the population appear to enter bays and estuaries farther north from Humboldt Bay, California to Grays Harbor,Washington (Lindley *et al.* 2011).

Green sturgeon feed on benthic invertebrates and fish (Adams *et al.* 2002). Radtke (1966) analysed stomach contents of juvenile green sturgeon captured in the Sacramento-San Joaquin Delta and found the majority of their diet was benthic invertebrates, such as mysid shrimp and amphipods (Corophium spp). Manual tracking of acoustically-tagged green sturgeon in the San Francisco Bay estuary indicates they are generally bottom-oriented, but make occasional forays to surface waters, perhaps to assist their movement (Kelly *et al.* 2007). Dumbauld *et al.* (2008) report green sturgeon utilize soft substrate in estuaries, presumably feeding on benthic invertebrates. Preliminary data from mapping surveys conducted in Willapa Bay, Washington, showed densities of "feeding pits" (*i.e.*, depressions in the substrate believed to be formed when green sturgeon feed) were highest over shallow intertidal mud flats, while harder substrates (*e.g.*, gravel) had no pits (M. Moser, unpublished data). Within the San Francisco estuary, green sturgeon are encountered by recreational anglers and during sampling by CDFW in the shallow waters of San Pablo Bay.

b. Status of Southern DPS Green Sturgeon and Critical Habitat

To date, little population-level data have been collected for green sturgeon. In particular, there are no published abundance estimates for either northern DPS or southern DPS green sturgeon in any of the natal rivers based on survey data. As a result, efforts to estimate green sturgeon population size have had to rely on sub-optimal data with known potential biases. Available abundance information is comes mainly from four sources: 1) incidental captures in the CDFW white sturgeon monitoring program; 2) fish monitoring efforts associated with two diversion facilities on the upper Sacramento River; 3) fish salvage operations at the water export facilities on the Sacramento-San Joaquin Delta; and 4) dual frequency sonar identification in spawning areas of the upper Sacramento River. These data are insufficient in a variety ways (*e.g.*, short time series, non-target species, *etc*.) and do not support more than a qualitative evaluation of changes in green sturgeon abundance.

CDFW's white sturgeon monitoring program incidentally captures southern DPS green sturgeon. Trammel nets are used to capture white sturgeon and CDFW (2002) utilizes a multiple-census or Peterson mark-recapture method to estimate the size of subadult and adult sturgeon population. By comparing ratios of white sturgeon to green sturgeon captures, estimates of southern DPS green sturgeon abundance can be calculated. Estimated abundance of green sturgeon between 1954 and 2001 ranged from 175 fish to more than 8,000 per year and averaged 1,509 fish per year. Unfortunately, there are many biases and errors associated with these data, and CDFW does not consider these estimates reliable. For larval and juvenile green sturgeon in the upper Sacramento River, information is available from salmon monitoring efforts at the Red Bluff Diversion Dam (RBDD) and the Glenn-Colusa Irrigation District (GCID). Incidental capture of larval and juvenile green sturgeon at the RBDD and GCID have ranged between 0 and 2,068 green sturgeon per year (Adams *et al.* 2002). Genetic data collected from these larval green sturgeon suggest that the number of adult green sturgeon spawning in the upper Sacramento River remained roughly constant between 2002 and 2006 in river reaches above Red Bluff (Israel and May 2010). In 2011, rotary screw traps operating in the Upper Sacramento River at RBDD captured 3,700 larval green sturgeon which represents the highest catch on record in 16 years of sampling (Poytress *et al.* 2011).

Juvenile green sturgeon are collected at water export facilities operated by DWR and Reclamation in the Sacramento-San Joaquin Delta. Fish collection records have been maintained by DWR from 1968 to present and by Reclamaiton from 1980 to present. The average number of southern DPS green sturgeon taken per year at the DWR facility prior to 1986 was 732; from 1986 to 2001, the average per year was 47 (70 FR 17386). For Reclamaiton's facility, the average number prior to 1986 was 889; from 1986 to 2001 the average was 32 (70 FR 17386). Direct capture in the salvage operations at these facilities is a small component of the overall effect of water export facilities on southern DPS green sturgeon; entrained juvenile green sturgeon are exposed to potential high levels of predation by non-native predators, disruption in migratory behavior, and poor habitat quality. Delta water exports have increased substantially since the 1970s and it is likely that this has contributed to negative trends in the abundance of migratory fish that utilize the Delta, including the southern DPS green sturgeon.

During the spring and summer spawning period, researchers with University of California Davis have utilized dual-frequency identification sonar to enumerated adult green sturgeon in the upper Sacramento River. These surveys estimated 175 to 250 sturgeon (±50) in the mainstem Sacramento River during the 2010 and 2011 spawning seasons (E. Mora, personal communication, January 2012). However, it is important to note that this estimate may include some white sturgeon, and movements of individuals in and out of the survey area confound these estimates. Given these uncertainties, caution must be taken in using these estimates to infer the spawning run size for the Sacramento River, until further analyses are completed.
The most recent status review update concluded the southern DPS green sturgeon is likely to become endangered in the foreseeable future due to the substantial loss of spawning habitat, the concentration of a single spawning population in one section of the Sacramento River, and multiple other risks to the species such as stream flow management, degraded water quality, and introduced species (NMFS 2005). Based on this information, the southern DPS green sturgeon was listed as threatened on April 7, 2006 (71 FR 17757).

Critical habitat was designated for the southern DPS of green sturgeon on October 9, 2009 (74 FR 52300) and includes coastal marine waters within 60 fathoms depth from Monterey Bay, California to Cape Flattery, Washington, including the Strait of Juan de Fuca to its United States boundary. Designated critical habitat also includes the Sacramento River, lower Feather River, lower Yuba River, Sacramento-San Joaquin Delta, Suisun Bay, San Pablo Bay, and San Francisco Bay in California. PCEs of designated critical habitat in estuarine areas are food resources, water flow, water quality, mitigation corridor, depth, and sediment quality. In freshwater riverine systems, PCEs of green sturgeon critical habitat are food resources, substrate type or size, water flow, water quality, migratory corridor, depth, and sediment quality. In nearshore coastal marine areas, PCEs are migratory corridor, water quality, and food resources. The current condition of critical habitat for the southern DPS of green sturgeon is degraded over its historical conditions. It does not provide the full extent of conservation values necessary for the recovery of the species, particularly in the upstream riverine habitat of the Sacramento River. In the Sacramento River, migration corridor and water flow PCEs have been impacted by human actions, substantially altering the historical river characteristics in which the southern DPS of green sturgeon evolved. In addition, the alterations to the Sacramento-San Joaquin River Delta may have a particularly strong impact on the survival and recruitment of juvenile green sturgeon due to their protracted rearing time in brackish and estuarine waters.

B. Factors Responsible for Steelhead, Chinook Salmon, and Green Sturgeon Stock Declines

NMFS cites many reasons (primarily anthropogenic) for the decline of steelhead (Busby *et al.* 1996), Chinook salmon (Myers *et al.* 1998), and southern DPS of green sturgeon (Adams *et al.* 2002, NMFS 2005). The foremost reason for the decline in these anadromous populations is the degradation and/or destruction of freshwater and estuarine habitat. Additional factors contributing to the decline of these populations include: commercial and recreational harvest, artificial propagation, natural stochastic events, marine mammal predation, reduced marine-derived nutrient transport, and ocean conditions.

1. Habitat Degradation and Destruction

The best scientific information presently available demonstrates a multitude of factors, past and present, have contributed to the decline of west coast salmonids and green sturgeon by reducing and degrading habitat by adversely affecting essential habitat features. Most of this habitat loss and degradation has resulted from anthropogenic watershed disturbances caused by urban development, agriculture, poor water quality, water resource development, dams, gravel mining, forestry (Busby *et al.* 1996, Adams *et al.* 2002, Good *et al.* 2005), and lagoon management (Smith 1990, Bond 2006).

2. Commercial and Recreational Harvest

Until recently, commercial and recreational harvest of southern DPS green sturgeon was allowed under State and Federal law. The majority of these fisheries have been closed (NMFS 2005). Ocean salmon fisheries off California are managed to meet the conservation objectives for certain stocks of salmon listed in the Pacific Coast Salmon Fishery Management Plan, including any stock that is listed as threatened or endangered under the ESA. Early records did not contain quantitative data by species until the early 1950's. In addition, the confounding effects of habitat deterioration, drought, and poor ocean conditions on salmonids make it difficult to assess the degree to which recreational and commercial harvest have contributed to the overall decline of salmonids and green sturgeon in West Coast rivers.

3. Artificial Propagation

Releasing large numbers of hatchery fish can pose a threat to wild salmon and steelhead stocks through genetic impacts, competition for food and other resources, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991).

4. Natural Stochastic Events

Natural events such as droughts, landslides, floods, and other catastrophes have adversely affected salmonid and sturgeon populations throughout their evolutionary history. The effects of these events are exacerbated by anthropogenic changes to watersheds such as logging, roads, and water diversions. These anthropogenic changes have limited the ability of salmonid and sturgeon to rebound from natural stochastic events and depressed populations to critically low levels.

5. Marine Mammal Predation

Predation is not known to be a major factor contributing to the decline of West Coast salmon and steelhead populations relative to the effects of fishing, habitat degradation, and hatchery practices. Predation may have substantial impacts in localized areas. Harbor seal (*Phoca* *vitulina*) and California sea lion (*Zalophus californianus*) numbers have increased along the Pacific Coast (NMFS 1997b).

In a peer reviewed study of harbor seal predation in the Alsea River Estuary of Oregon, the combined results of multiple methodologies led researchers to infer that seals consumed 21 percent (range = 3–63 percent) of the estimated prespawning population of coho salmon. The majority of the predation occurred upriver, at night, and was done by a relatively small proportion of the local seal population (Wright *et al.* 2007).

However, at the mouth of the Russian River, Hanson (1993) reported that the foraging behavior of California sea lions and harbor seals with respect to anadromous salmonids was minimal, and predation on salmonids appeared to be coincidental with the salmonid migrations rather than dependent upon them.

6. Reduced Marine-Derived Nutrient Transport

Marine-derived nutrients from adult salmon carcasses have been shown to be vital for the growth of juvenile salmonids and the surrounding terrestrial and riverine ecosystems (Bilby *et al.* 1996, Bilby *et al.* 1998, Gresh *et al.* 2000). Declining salmon and steelhead populations have resulted in decreased marine-derived nutrient transport to many watersheds. Nutrient loss may be contributing to the further decline of ESA-listed salmonid populations (Gresh *et al.* 2000).

7. Ocean Conditions

Recent evidence suggests poor ocean conditions played a significant role in the low number of returning adult fall run Chinook salmon to the Sacramento River in 2007 and 2008 (Lindley *et al.* 2009). Changes in ocean conditions likely affect ocean survival of all west coast salmonid populations (Good *et al.* 2005, Spence *et al.* 2008).

C. Global Climate Change

Global climate change presents an additional potential threat to anadromous salmonids, green sturgeon and designated critical habitat. Modeling of climate change impacts in California suggests that average summer air temperatures are expected to increase (Lindley *et al.* 2007). Heat waves are expected to occur more often, and heat wave temperatures are likely to be higher (Hayhoe *et al.* 2004). Total precipitation in California may decline; critically dry years may increase (Lindley *et al.* 2007, Schneider 2007). The Sierra Nevada snow pack may decrease by as much as 70 to 90 percent by the end of this century under the highest emission scenarios modeled (Luers *et al.* 2006). Wildfires are expected to increase in frequency and magnitude, by as much as 55 percent under the medium emissions scenarios modeled (Luers *et al.* 2006). Vegetative cover may also change, with decreases in evergreen conifer forest and increases in grasslands and mixed evergreen forests. The likely change in amount of rainfall in Northern and Central Coastal streams under various warming scenarios is less certain, although as noted above, total rainfall across the state is expected to decline.

For the California North Coast, some models show large increases (75 to 200 percent) in rainfall amounts while other models show decreases of 15 percent to 30 percent (Hayhoe *et al.* 2004). It has been estimated that snowmelt contribution to runoff in the San Francisco Bay and San Joaquin Delta may decrease by about 20 percent per decade over the next century (Cloern *et al.* 2011). Many of these changes are likely to further degrade CCC steelhead habitat by reducing stream flows during the summer and raising summer water temperatures. Estuaries may also experience changes detrimental to salmonids. Estuarine productivity is likely to change based on changes in sea level, freshwater flows, nutrient cycling, and sediment amounts (Scavia *et al.* 2002, Cloern *et al*. 2011). In marine environments, ecosystems and habitats important to juvenile and adult salmonids are likely to experience changes in temperatures, circulation, water chemistry, and food supplies (Brewer and Barry 2008, Feely 2004, Osgood 2008, Turley 2008). The projections described above are for the mid to late 21st Century. In shorter time frames, climate conditions not caused by the human addition of carbon dioxide to the atmosphere are more likely to predominate (Cox and Stephenson 2007, Smith *et al.* 2007).

V. ENVIRONMENTAL BASELINE

As described above, Suisun Marsh is bounded to the west, north, and east by hills, and to the south by Suisun, Grizzly, and Honker bays. Montezuma Slough, the largest slough in the action area, runs from east to west between the Sacramento-San Joaquin Delta and Suisun Bay. Major bodies of water draining to Montezuma Slough include Little Honker Bay, and Denverton and Nurse sloughs. The second largest slough in the action area is Suisun Slough, which essentially splits the marsh into eastern and western portions. Tributaries to Suisun Slough include Cordelia and Goodyear Sloughs, and several small dead-end sloughs.

The marsh includes approximately 116,000 acres, of which 52,000 acres are privately or publicly owned managed wetlands. Of the remaining 64,000 acres, most are bays, sloughs, and upland grasslands. Approximately 6,300 acres are unmanaged tidal wetlands and 2,025 acres are permanently flooded wetlands. Networks of tidal sloughs, principally tributaries of Suisun and Montezuma Sloughs, crisscross the marsh. These tidal sloughs and unmanaged tidal wetlands provide over 40,000 acres of habitat for listed species.

Land-use activities such as levee construction, water management, and recreation are pervasive and have degraded habitat quantity and quality for ESA-listed salmonids and green sturgeon through alteration of bank and channel morphology; alteration of ambient water temperatures and salinity levels; elimination of rearing habitat; and fragmentation of available habitats.

Levee building beginning in the mid-1880s has excluded Chinook salmon, steelhead, and green sturgeon from 90 percent of the tidal wetlands that existed historically in the action area. Levees range from 4 to 8 feet above ground, and most of the wetlands are at or below mean tide elevation. Water is diverted from tidal sloughs into managed wetlands at high tides. At low tides, water drains from managed wetlands to tidal sloughs through outlet structures throughout the marsh. These water diversion intakes and drains are described in detail in SRCD and CDFW (2005).

When tidal waters are diverted into managed wetlands, their subsequent temperature, salinity, dissolved oxygen levels, and pH may vary from ambient conditions in adjacent tidal sloughs.

The California Department of Water Resources (DWR) has monitored the quality of drain water from selected ownerships in Suisun Marsh since 1965. On average, salinity and temperature levels in drain water were similar to or slightly higher than ambient levels (SRCD and CDFW 2005). Other water quality parameters (pH, dissolved oxygen) in drain water were comparable to ambient levels.

Although there has been much levee construction, subsequent development of the reclaimed land has been limited. In 1974, the California Legislature enacted the Suisun Marsh Preservation Act that protected Suisun Marsh from urban development. The Suisun Marsh Preservation Act required the San Francisco Bay Conservation and Development Commission to develop a plan for the Marsh and provides for various restrictions on development within Marsh boundaries. The Bay Conservation and Development Commission created the Suisun Marsh Protection Plan in 1976. Most of the pre-existing development within the Marsh was either agricultural or recreational. These land uses can continue under the Suisun Marsh Protection Plan. Agricultural practices have contributed to the degradation of salmonid and sturgeon habitat in Suisun Marsh through alterations to tidal flow patterns, discharge of drainage water, damage to riparian areas, reduction in diversity of native vegetation, and water quality degradation. The major recreation pursuit in Suisun Marsh is waterfowl hunting. Waterfowl hunting in Suisun Marsh relies on constructed levees and alterations to tidal flow and drainage patterns to maximize waterfowl production. These changes to the landscape of Suisun Marsh have affected ESA-listed fish by altering natural estuarine processes and conversion of estuarine habitat to managed ponds for waterfowl.

A. Marsh Regions

To assist in the environmental analysis of the 116,000 acre area of Suisun Marsh, the action area was divided into four regions with similar characteristics (Figure 1, Appendix). Regional characteristics include the size of surrounding sloughs, tidal movements, freshwater inflows, and the operations of the region's intake and discharge structures.

1. Region 1

The western and northwestern portions of the marsh in Region 1 flood from, and drain to, small to medium sloughs. These are primarily tributaries to Suisun and Cordelia sloughs. Sloughs in Region 1 are influenced by freshwater inflows from Green Valley, Suisun, and Ledgewood Creeks. Region 1 also has several small sloughs tributary to Suisun and Cordelia sloughs (*e.g.*, Peytonia Slough) where tidal exchange is minimal. These dead-end sloughs periodically have poor water quality from what are called "black water" events, when anaerobic bacterial decomposition of vegetation in managed wetlands results in extremely low dissolved oxygen (DO). When black water is drained from managed wetlands, water quality in receiving slough waters are likely to be degraded. During monthly sampling at nine locations across the action area, researchers from the University of California, Davis, have documented these events since 1999 (Schroeter and Moyle 2004). These events have occurred in May, June, and October. Oxygen levels less than 1 milligram/liter (mg/L) have been recorded in lower Goodyear Slough, Boynton Slough, and Peytonia Slough; these conditions may persist or reoccur in some areas for up to two months. The levels are sufficient to cause fish mortality, as Schroeter and Moyle

(2004) report observations of 32 dead adult Chinook salmon in Suisun Slough in October 2003 and 2 dead adult Chinook salmon in Suisun Slough in October 2004[4]. Adult salmon attempting to migrate upstream may be delayed from passing through the area to freshwater spawning areas or may die while attempting to pass through the area.

Areas of persistent low dissolved oxygen levels, however, have not been recorded in other regions of the action area, and appear to be limited to a few locations in Region 1 where tidal exchange is minimal. Because diurnal tidal cycles typically restore ambient conditions within a tidal cycle, sloughs with larger tidal exchanges do not appear to be affected by these events. SRCD has worked with landowners to reduce the extent and severity of these events, and to improve dissolved oxygen levels in drain water. Management modifications have included elimination of discharges to dead-end sloughs with minimal tidal exchange (Boynton and Peytonia Sloughs); relocation of discharges to a more tidally energetic channel (Suisun Slough); discouraging and mowing broad leaved vegetation prior to flood-up to reduce oxygen demand during decomposition; increasing circulation to improve aerobic conditions; and rapid flooding and draining to encourage aerobic decomposition. These changes in management are included in the project proposal. Anecdotal evidence suggests that these that these management modifications are effective in reducing or eliminating black water events, but data supporting that conclusion are not currently available.

2. <u>Region 2</u>

The central portion of the marsh in Region 2 is characterized by wetlands that flood off small tidal sloughs, and drain primarily to Suisun or Montezuma sloughs, the largest tidal sloughs in the marsh. These receiving sloughs have maximal tidal exchange, and degraded water has not been documented in this Region.

3. <u>Region 3</u>

The central and southern portions of the marsh are within Region 3 and this area forms the largest geographic region of the marsh. The main slough in the Region is Montezuma Slough, which is influenced by large daily tidal movements, Delta outflow, wind, and the Suisun Marsh Salinity Control Structure. CDFW, SRCD, and NMFS prioritized diversion intakes that posed the greatest risks of entrainment to listed species, and intakes along Montezuma Slough were identified as the highest priority for screening to exclude juvenile salmonids migrating through the slough (based on data from the Suisun Marsh Fish Monitoring program). Sixteen screens were installed between 1996 and 1998. Thirteen of these were installed on private property, two were installed on CDFW property at Joice Island, and one was installed at the large Roaring River Distribution System operated by DWR (SRCD and CDFW 2005). The Region now diverts the majority of water through fish screens (18 fish screens), preventing entrainment on over 19,958 acres of managed wetlands. During fall flood up prior to November 1, some additional water may be diverted from Montezuma Slough via secondary, unscreened intakes. Most of the wetlands divert water from Montezuma Slough, and drain to the large tidal water-bodies of Montezuma Slough, or Grizzly, Suisun, or Honker Bays. As in Region 2, these

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[4] Based on the timing of exposure to degraded water quality conditions, these fish were likely Fall Run Central Valley Chinook salmon, which are not listed under the ESA.

receiving sloughs have maximal tidal exchange, and degraded water quality has not been documented in Region 3.

NMFS is aware of three actions that improved conditions for ESA-listed salmonids and green sturgeon in Region 3[5]. In the fall of 2005 a fish screen was installed on Montezuma Slough at the diversion point for the Grizzly Island Wildlife Area. In 2005, on Lower Joice Island, about 25 brush boxes were installed; and have performed well. In October of 2006 at Blacklock restoration site, a collaborative effort led to a planned levee breach that restored 70 acres of Suisun Marsh to tidal wetlands.

4. Region 4

The northwestern portion of the marsh in Region 4 is characterized by wetland units that flood and drain primarily into medium to large tidal sloughs (Nurse and Loco Sloughs) and Little Honker Bay. These receiving sloughs have maximal tidal exchange, and degraded water quality has not been documented in Region 4.

B. Suisun Marsh Salinity Control Structure

The Suisun Marsh Salinity Control Structure spans the width of Montezuma Slough and is located about two miles west of the slough's confluence with the Sacramento-San Joaquin Delta. The structure includes radial gates, permanent barriers adjacent to levees on each side of the channel, removable flashboards, and a boat lock. The structure is operated by DWR from September through May to lower the salinity from Collinsville through Montezuma Slough into the eastern and central portion of Suisun Marsh. The structure also retards the movement of higher salinity water from Grizzly Bay into the western marsh. During full gate operation, the flashboards are installed and the radial gates open and close twice each tidal day. During ebb tides, the gates are open to allow the normal flow of lower salinity water from the Sacramento River to enter Montezuma Slough. During flood tides, the gates are closed to retard the upstream movement of higher salinity water from Grizzly Bay.

Adult salmonid passage has been monitored at the structure since 1993. During the operation season (between October and May), the structure has been shown to delay upstream migration of adult salmonids (DWR and CDFW 2005). Recent operational improvements have minimized upstream delays and adult salmonids can successfully pass upstream through the boat lock structure on the facility. Green sturgeon are thought to successfully pass through either the boat lock or through the gates during periods when the gates are open.

The operation and maintenance of the Suisun Marsh Salinity Control Structure by DWR was addressed in a comprehensive ESA section 7 consultation with Reclamation regarding operation of California's Central Valley water projects. During this formal consultation with Reclamation, NMFS analyzed the effects of the Suisun Marsh Salinity Control Structure on listed anadromous salmonids, green sturgeon and designated critical habitat. In the resulting Biological Opinion and Conference Opinion for the Long-Term Operation of the Central Valley Project and State Water Project (CVP/SWP operations) dated June 4, 2009, (NMFS 2009), NMFS concluded that

[5] Electronic mail message from S Chappell to D. Logan on December, 27, 2007.

the structure does not change habitat suitability or availability for rearing or migration of listed salmonids and green sturgeon, but it does impair adult salmonid upstream passage. However, the anticipated delays in adult salmonid migration will not jeopardize listed species. This formal consultation is briefly discussed below in Section V.E. *Previous Section 7 Consultations and Section 10 Permits in the Action Area*. The Suisun Marsh Salinity Control Structure has been addressed in the biological and conference opinion for CVP/SWP operations issued to Reclamation on June 4, 2009, and is not analyzed further in this biological opinion.

C. Status of Listed Species and Critical Habitat in the Action Area

1. <u>CCC Steelhead, CV Steelhead, CV Spring-Run Chinook Salmon, Sacramento River Winter-Run Chinook Salmon, and southern DPS of green sturgeon</u>

Although available data indicates abundance in the action area is low, winter-run Chinook salmon, CV spring-run Chinook salmon, CCC steelhead, CV steelhead, and individuals from the southern DPS of North American green sturgeon, are seasonally present in the tidal sloughs of Suisun Marsh. Juvenile salmonids and green sturgeon use Suisun Marsh both as a migratory pathway and rearing area as they move downstream through the San Francisco Bay-Delta Estuary to the Pacific Ocean. Listed juvenile salmonids enter the action area at smolt stage, and are expected to be actively emigrating. The action area also provides migratory habitat for adult salmonids and green sturgeon.

Montezuma Slough (Figure 1, Appendix) is located between Central Valley salmonid freshwater spawning and rearing habitat and the Pacific Ocean. Although not the primary migration route through Suisun Bay, a proportion of salmonid species migrating to and from the Sacramento River travel through Montezuma Slough. Movement studies have estimated that between 0.81 and 2.74 percent of all migrating juvenile fall-run Chinook salmon utlize Montezuma Slough as a migratory route to the ocean (USFWS 1993, SRCD and CDFW 2005). Based on their close taxonomic relationships, and similarities in their life history patterns and migratory habits, NMFS expects that these estimates are reasonabale surrogates for the proportion of winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead that migrate through Montezuma Slough.

Since 1979, the University of California, Davis has conducted the Suisun Marsh Fish Monitoring (SMFM) program. Samples are taken monthly from nine sloughs, with sampling stations in each Region of the action area. Sampling stations represent both small dead-end sloughs and large sloughs. The SMFM sampling program is conducted with an otter trawl and some beach seining. Although the SMFM program has documented small numbers of salmonids, their methods target slower moving estuarine species, and are not effective at capturing fish with strong swimming abilities such as salmonids. These fish are able to swim away from the otter trawl.

Another long-term fisheries monitoring effort is conducted a short distance upstream of the action area near the confluence of the Sacramento and San Joaquin rivers. Midwater trawl surveys have been conducted by CDFW and the USFWS near Chipps Island from 1993 through 2007. This sampling targeted salmon and steelhead originating from Central Valley streams. Trawl results indicate smolts enter Suisun Bay as early as December and as late as July, but for most years peak abundances fell during the fall-run Chinook salmon emigration season between April and June. Suisun Bay is adjacent to Suisun Marsh and, thus, this sampling provides an indicator of salmonid presence in Suisun Marsh. This sampling method was unlikely to capture adult salmonids because their strong swimming ability allows them to swim away from the trawl.

Results from the SMFM program and other studies indicate the greatest numbers of salmonid smolts occur in Region 3, followed by Region 4. Sampling has shown that small numbers of smolts occur in regions 1 and 2. The results of salmonid collections in Suisun Marsh fisheries investigations are presented by region in the following paragraphs.

In Region 1, the SMFM program samples Goodyear and Suisun sloughs, and two smaller dead-end sloughs; Boynton and Peytonia sloughs. Between 1980 and 2001, only two Chinook smolts were captured in Region 1 by the SMFM program (SRCD and CDFW 2005). The SMFM program captured one steelhead smolt in Peytonia Slough, a dead-end tributary to upper Suisun Slough (SRCD and CDFW 2005). This smolt was likely part of the CCC steelhead DPS.[6] CCC steelhead utilize lower Suisun Slough and Cordelia Slough in Region 1 as migratory route to and from spawning and rearing habitat in two small streams tributary to Cordelia Slough (Green Valley Creek and Suisun Creek). Surveys conducted in Green Valley and Suisun creeks have documented the presence of juvenile CCC steelhead in these watersheds, but do not provide abundance data (Sanford 1999 and 2001, Hanson Environmental, Inc. 2002).

To determine the entrainment rate of fish at a large unscreened diversion, a two-year study occurred at the Morrow Island Distribution Center on Goodyear Slough[7]. Between 2003 and 2005 no listed salmonids or green sturgeon were detected in the fish entrainment studies at Morrow Island, but did capture two non-listed fall-run Chinook salmon[8].

In Region 2, sampling efforts by the SMFM program between 1980 and 2001 captured 29 Chinook salmon smolts, primarily in lower Suisun and Montezuma sloughs (SRCD and CDFW 2005).

In Region 3, the SMFM program has regularly documented Chinook salmon smolts in upper Montezuma Slough, with 573 fish observed between 1980 and 2001 (SRCD and CDFW 2005). In 1999 and 2000, four CV steelhead smolts were captured in Region 3, in Montezuma Slough (SRCD and CDFW 2005).

In Region 4, the large Nurse Slough, and smaller dead-end Denverton Slough are sampled by the SMFM program. One hundred and sixty Chinook salmon smolts have been documented in lower Denverton, Montezuma, and Nurse sloughs between 1982 and 2003 (SRCD and CDFW 2005). Four CV steelhead smolts have been recorded in Denverton Slough (SRCD and CDFW 2005).

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[6] The eastern most spawning streams for CCC steelhead are tributaries to Suisun Slough. Steelhead found east of that slough are considered to be CV steelhead.

7 Interagency Ecological Program (IEP) for the San Francisco Estuary newsletter, volume 20, number 1, winter 2007.

[8] Interagency Ecological Program (IEP) for the San Francisco Estuary newsletter, volume 20, number 1, winter 2007.

While the SMFM sampling methods are not designed to capture fast moving salmonids, the scarcity of captures over a relatively long period of sampling suggests that Chinook salmon smolts utilize Regions 1, 2, and 4 infrequently and in low numbers. The available data also suggest that Chinook salmon smolts do migrate through Montezuma Slough in Region 3. Chinook salmon smolts may also utilize tidal sloughs as foraging habitat during emigration, particularly those tributary to their migratory routes (*e.g.*, Nurse or Denverton sloughs in Region 4). Additional data regarding fish presence in Suisun Marsh is available from a variety of sources, including the Interagency Ecological Program, the Bay-Delta and Tributaries database (BDAT), and CDFW trawl survey data (SRCD and CDFW 2005).

Emigrating winter-run Chinook salmon and CV spring-run Chinook salmon are thought to pass through the estuary fairly rapidly (MacFarlane and Norton 2002, Moyle 2002). The smolts of these species are larger in size than fall-run smolts, because they generally reside in freshwater for approximately one year prior to emigration. They are typically ready to smolt upon entering the Sacramento-San Joaquin Delta upstream of the action area; therefore, they are believed to spend little time rearing in the action area. Juvenile fall-run Chinook salmon reside in fresh water for 4 to 6 months prior to smoltification and, thus, are considerably smaller smolts than winter-run Chinook salmon or CV spring-run Chinook salmon. Juvenile fall-run Chinook salmon were found to spend about 40 days migrating through the Delta to the mouth of San Francisco Bay and grew little in length or weight until they reached the Gulf of the Farallones (MacFarlane and Norton 2002). Based on these results, MacFarlane and Norton (2002) concluded that unlike other salmonid populations in the Pacific Northwest, Central Valley Chinook salmon show little estuarine dependence and may benefit from expedited ocean entry.

The SMFM data described above indicate that CV steelhead smolts migrate through Montezuma Slough in Region 3, and may utilize at least some of its larger tributaries as foraging habitat. CCC steelhead which spawn and rear in Suisun and Green Valley creeks must utilize lower Suisun and Cordelia sloughs in Region 1 as migratory habitat. According to a letter from the SRCD (dated March 16, 2004), Suisun Creek typically discharges into Cordelia Slough and then into lower Suisun Slough (SRCD 2004). The downstream flow may also diverge from Cordelia Slough into Chadbourne Slough and thence to Suisun Slough (SRCD 2004), and this route may also be utilized by steelhead migrants. As with Chinook salmon, the limited data available supports the hypothesis that steelhead smolts utilize tidal sloughs in the action area infrequently and in low numbers. Migration primarily occurs from January through May. Steelhead smolts may also utilize tidal sloughs, particularly those tributary to their migratory routes (*e.g.*, Denverton Slough in Region 3), as foraging habitat during the spring.

Juvenile green sturgeon have been captured in Region 1 in Goodyear Slough, and in Region 4 in Denverton Slough. Researchers at the University of California Davis have used telemetry to track five sub-adults and one adult green sturgeon in the San Francisco Estuary (WFCB 2005). Of the fish that were tracked, one was recorded in Region 4, near Honker Bay. Others were recorded downstream of the action area, in the Carquinez Straits, San Pablo Bay, and San Francisco Bay. Too few green sturgeon have been documented in the action area to draw conclusions about their occurrence. Therefore, based on the known life history of the species (as described above in *Species Life History and Population Dynamics*), it is assumed juvenile green sturgeon could be present in all regions of Suisun Marsh throughout the year. Catch data from CDFW trawls between 1980 and 2001 show green sturgeon in Suisun Bay range between 200 and 546 mm in length with an average length of 400 mm (CDFW unpublished data).

2. Sacramento River Winter-Run Chinook Salmon Critical Habitat

The Project's action area is designated critical habitat for Sacramento winter-run Chinook salmon. Features of designated critical habitat for winter-run Chinook salmon in the action area essential for their conservation are habitat areas and adequate prey that are uncontaminated. These physical and biological features of designated critical habitat within the action area are partially degraded and limited. Habitat degradation in the action area is primarily due to altered and diminished freshwater inflow, levee construction, loss and reduced access to tidal marsh habitat, and non-native invasive species.

3. Green Sturgeon Critical Habitat

The action area is located within designated critical habitat for the southern DPS of green sturgeon. PCEs for green sturgeon in estuarine areas are: food resources, water flow, water quality, migratory corridor, water depth, and sediment quality. These PCEs for green sturgeon critical habitat in the area are partially degraded. Habitat degradation in the action area is primarily due to altered and diminished freshwater inflow, levee construction, loss and reduced access to tidal marsh habitat, and non-native invasive species.

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D. Factors Affecting the Species Environment in the Action Area

Profound alterations to the environment of the greater San Francisco Bay estuary began with the discovery of gold in the middle of the 19th century. Dam construction, water diversion, hydraulic mining, and the diking and filling of tidal marshes soon followed, launching the San Francisco Bay area into an era of rapid urban development and coincident habitat degradation. There are efforts currently underway to restore the habitat in the Bay, if not directly within the action area, at least within surrounding tributaries and the estuary itself. There have also been alterations to the biological community as a result of human activities, including hatchery practices and the introduction of non-native species.

The action area has been highly modified by levee construction and creation of managed wetlands for waterfowl. Levee building beginning in the mid-1880s has excluded salmonids and sturgeon from 90 percent of the tidal wetlands that existed historically. Land-use activities such as levee construction, water management, and recreation are pervasive and have degraded habitat quantity and quality for Chinook salmon, steelhead, and green sturgeon through alteration of bank and channel morphology; alteration of ambient water temperatures and salinity levels; elimination of rearing habitat; and fragmentation of available habitats.

E. Previous Section 7 Consultations and Section 10 Permits in the Action Area

NMFS has completed two previous consultations with the Corps on RGP 3 for maintenance activities within Suisun Marsh. The first consultation in 1994 only addressed winter-run

Chinook salmon, because that was the only listed species in the action area under the jurisdiction of NMFS at that time. Formal consultation was conducted for a multi-year regional general permit. During consultation, it was determined that some juvenile winter-run Chinook salmon will likely be entrained through unscreened water intakes at managed wetland areas. Through agreement with CDFW, SRCD, and the Corps, water diversions at unscreened intakes in certain sloughs were curtailed during the peak outmigration season of juvenile winter-run Chinook salmon smolts (November through May). These water diversion restrictions, along with those imposed for the seasonal protection of Delta smelt, were incorporated by the Corps as special conditions in RGP 3. Consultation between the Corps and NMFS was concluded with NMFS issuance of a biological opinion dated September 21, 1994. In this opinion, NMFS determined that the proposed action was not likely to jeopardize the continued existence of winter-run Chinook salmon or adversely modify critical habitat.

NMFS and the Corps completed a second formal consultation on the re-issuance of RGP 3 for winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, CCC steelhead and green sturgeon in 2008. The measures developed in the 1994 consultation for RGP 3 were incorporated by the Corps as permit special conditions. A biological opinion was issued on January 16, 2008 which concluded the proposed re-issuance of RGP 3 was not likely to jeopardize the continued existence of listed salmonids, green sturgeon, or adversely modify critical habitat.

As discussed above in Section V.B. *Suisun Marsh Salinity Control Structure*, NMFS and Reclamation completed formal consultation in 2009 on the operation and maintenance of the Suisun Marsh Salinity Control Structure. The consultation addressed the effects of DWR's operation and maintenance of this facility on listed salmonids, green sturgeon and designated critical habitat. The June 4, 2009, Biological Opinion and Conference Opinion for CVP/SWP operations concluded that the structure does not change habitat suitability or availability for rearing or migration of listed salmonids and green sturgeon, but it does impair adult salmonid upstream passage. However, the anticipated delays in adult salmonid migration will not jeopardize listed species.

Since 1991, pursuant to section 7 of the ESA, NMFS has conducted 48 interagency consultations within the action area of this project. Of these 48 consultations, 34 were with the Corps, eight were with Reclamation, two were with U.S. Department of Transportation, one was with the U.S. Maritime Administration, one was with the U.S. Coast Guard, one was with the U.S. Navy, and one was with the Federal Highway Administration. These consultations were primarily related to maintenance of existing infrastructure in Suisun Marsh and along the shoreline of Suisun Bay (*i.e.*, shoreline protection; repair of wharves, docks and piers; replacement of storm water outfalls; and maintenance of utilities infrastructure). A small number of consultations have been conducted for sand mining. NMFS determined that most (they were not likely to adversely affect listed salmonids or green sturgeon or their critical habitat. For those projects with adverse effects on listed salmonids and green sturgeon and/or critical habitat, NMFS determined that they were not likely to jeopardize the continued existence of listed salmonids or adversely modify critical habitat. Adverse effects that resulted from these projects are not anticipated to affect the current population status of listed salmonids or green sturgeon.

Research and enhancement projects resulting from NMFS' Section 10(a)(1)(A) research and enhancement permits and section 4(d) limits or exceptions could potentially occur in Suisun Marsh. Salmonid and sturgeon monitoring approved under these programs includes juvenile and adult net surveys and tagging studies. In general, these activities are closely monitored and require measures to minimize take during the research activities. Through early summer 2013, no research or enhancement activities have occurred in Suisun Marsh.

VI. EFFECTS OF THE ACTION

Pursuant to section 7(a)(2) of the ESA (16 U.S.C. §1536), Federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. This biological opinion assesses the effects on ESA-listed anadromous salmonids and the southern DPS of green sturgeon associated with the implementation of the SMP, During the next 30-year period, the Corps proposes re-issuance of RGP 3 at five-year intervals and an LOP at 10-year intervals, and Reclamation proposes to continue cost-share funding of the Suisun Marsh Preservation Agreement and the Preservation Agreement Implementation Fund.

Maintenance and operations activities undertaken within Suisun Marsh may affect endangered winter-run Chinook salmon and their designated critical habitat, threatened CV spring-run Chinook salmon, threatened CCC steelhead, threatened CV steelhead, and threatened southern DPS of North American green sturgeon and its designated critical habitat. The proposed action is likely to adversely affect those listed salmonids and green sturgeon and their habitat primarily through entrainment and degraded water quality resulting from managed wetland operations and some construction activities. In the *Description of the Proposed Action* section of this opinion, NMFS provided an overview of the action. In the *Status of the Species* and *Environmental Baseline* sections of this opinion, NMFS provided an overview of the threatened and endangered species and critical habitats that are likely to be adversely affected by the activity under consultation.

Regulations that implement section 7(a)(2) of the ESA require that biological opinions evaluate the direct and indirect effects of Federal actions and interrelated or interdependent actions to determine whether the effects of those actions are expected to reduce numbers or distribution of ESA-listed species, thereby resulting in an appreciable reduction of the likelihood of survival or recovery of those species in the wild.(16 U.S.C. §1536, 50 CFR §402.02).

NMFS generally approaches "jeopardy" analyses in a series of steps. First, NMFS evaluates the available evidence to identify direct and indirect physical, chemical, and biotic effects of the proposed actions on individual members of listed species or aspects of the species' environment (these effects include direct, physical harm or injury to individual members of a species; modifications to something in the species' environment - such as reducing a species' prey base, enhancing populations of predators, altering its spawning substrate, altering its ambient temperature regimes; or adding something novel to a species' environment - such as introducing exotic competitors or a sound). Once NMFS has identified the effects of the action, the available evidence is evaluated to identify a species' probable response, including behavioral reactions, to these effects. These responses then will be assessed to determine if they can reasonably be expected to reduce a species' reproduction, numbers, or distribution (for example, by changing birth, death, immigration, or emigration rates; increasing the age at which individuals reach sexual maturity; decreasing the age at which individuals stop reproducing; among others). The available evidence is then used to determine if these reductions, if there are any, could reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild.

The regulatory definition of adverse modification has been invalidated by the courts. Until a new definition is adopted, NMFS will evaluate destruction or adverse modification of critical habitat by determining if the action reduces the value of critical habitat for the conservation of the species.

The presence of each species by life history stage during the proposed operations and maintenance activities is shown in Table 7. In addition to presence, the distribution of species within each of the four regions described above provides information on what life stage may be affected by specific managed wetland operations or maintenance activities. Adverse effects associated with operations include exposure to degraded water quality from draining wetlands and entrainment at water diversions. Maintenance activities authorized under RGP 3 may lead to temporary increases in turbidity. Maintenance dredging activities authorized with an LOP may result in some mechanical injury to green sturgeon, temporary increases of turbidity, and disruption of substrate fauna. In this biological opinion, NMFS analyzed the effects of these operations and activities for a 30-year period.

NMFS analyzed the operational and maintenance activities in each Region, the listed species likely to be present in each Region, and the relationship between the life history strategy of each species and the risk posed by each activity. Based on this analysis, NMFS determined those species or life history stages most likely to be exposed to adverse effects by Region. Proposed best management practices, proposed improvements to wetland management, and proposed curtailments and restrictions on water diversions were considered.

A. Operation and Maintenance of Managed Suisun Marsh Wetland Areas

1. <u>Water Quality</u> Effects at Managed Wetlands.

As described in the *Environmental Baseline* section, managed wetlands are drained during ebb tides on a seasonal cycle. When the temperature, salinity, pH, and dissolved oxygen levels of drain water is similar to ambient conditions in receiving sloughs it is unlikely to adversely affect listed species or critical habitat, because each species can tolerate small fluctuations in these water quality parameters. Monitoring results show that on average, salinity and temperature levels in drain water are similar to or slightly higher than ambient levels, and other parameters are comparable to ambient levels (SRCD and CDFW 2005). In most Suisun Marsh sloughs, diurnal tide cycles provide adequate circulation to avoid large fluctuations in water quality parameters. Only small, localized changes in water quality are expected in Regions 2, 3, and 4 of Suisun Marsh, because wetlands in these regions drain into medium and large sloughs with good tidal circulation. However, a few small dead-end sloughs in Region 1 have little tidal exchange and low dissolved oxygen conditions may persist during May, June, or October. Improvements to managed wetland operations in Region 1 have been developed in recent years and are expected to decrease the frequency, severity, and duration of these events. However, degraded conditions resulting from drainage in some localized areas of Region 1 may exceed the tolerance of listed species, and adverse effects may occur.

It is not likely that adult or smolt life stages of winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead will enter the affected areas of Region 1, because those areas are beyond the migratory routes of those species. If individuals of those species strayed from typical migration routes, the affected areas with poor water quality present conditions which are well below the preferred range of salmonids (Spence *et al.* 1996). However, migrating adult Chinook salmon typically avoid areas of poor water quality, and we assume that migrating Chinook salmon smolts and migrating adult and smolt CV steelhead will behave similarly when encountering areas of poor water quality. Since the areas within Suisun Marsh affected by poor water quality are remote from the migratory pathways of listed Central Valley listed salmonids, it is unlikely listed Central Valley salmonids will encounter these areas.

CCC steelhead adults and smolts passing to and from Suisun Creek and Green Valley Creek pass through portions of Region 1, via Cordelia and Suisun sloughs. Although low dissolved oxygen events have not been documented on the main migratory routes between Suisun bay and these steelhead streams, poor water quality sites have occurred in small dead-end sloughs tributary to these routes (Schroeter and Moyle 2004). Steelhead that enter these dead-end sloughs could encounter degraded conditions. Those emigrating CCC steelhead exposed to poor water conditions may experience adverse effects including interrupted migration and perhaps mortality (Schroeter and Moyle 2004). Extended exposure to low dissolve oxygen conditions is known to impair salmonid metabolic rate, growth, swimming performance, and overall survival (Barnhart 1986). The peak emigration of steelhead smolts is expected to occur between March and early May and will likely coincide with higher stream flow events. The upstream migration of adult steelhead typically occurs from January through April during high flow events. Water quality in these sloughs is expected to improve during high flow events and afford protection to CCC steelhead from low DO levels associated with the discharge of black water. Therefore, the timing of steelhead migration during high flow events combined with the low probability of fish entering the smaller dead-end sloughs of Suisun Marsh make it unlikely steelhead will experience degraded water quality conditions. Black water events have been recorded in May, June and October, which make it very unlikely to occur during the adult CCC steelhead migration season. Fisheries sampling reported in Crain and Moyle (2011) in slough areas subject to low DO levels did not encounter any steelhead. However, over the 30-year term of the SMP there is a low probability that an unknown, but very small number of CCC steelhead smolts will encounter low dissolved oxygen levels related to a black water discharge event. NMFS estimates that no more than 20 CCC steelhead smolts will be harmed or killed by low dissolved oxygen levels during black water events over the 30-year term of the SMP.

Green sturgeon may be present in Region 1 during these low dissolved oxygen events and past black water discharges have include areas designated as critical habitat for green sturgeon. For adult green sturgeon, localized areas of low dissolved oxygen levels may inhibit upstream migration. However, the small dead-end sloughs in Region 1 where these events have occurred are more than five miles distant from the major migratory routes to spawning grounds in the upper Sacramento River. Therefore, it is not likely that adult green sturgeon will be present in Region 1. Juvenile green sturgeon may experience degraded water quality conditions in Region 1 in May, June, and October. Green sturgeon are tolerant of DO levels ranging from 2 to 5 mg/l (Crain and Moyle 2011). It is unknown how juvenile green sturgeon will respond to low dissolved oxygen conditions; however, fish are known to leave areas when oxygen levels fall below 2 mg/L (Dybas 2005). In addition, the affected areas in Region 1 represent a small proportion of the marsh and the events are generally a small portion of the year. Since juvenile green sturgeon are expected to be distributed throughout the action area, only a very small number of green sturgeon are likely to be affected by black water discharge events. As a result, an unknown, but likely small number of green sturgeon may be unable to avoid poor conditions occurring in Region 1, and may be harmed or killed by low dissolved oxygen levels. Fisheries sampling reported in Crain and Moyle (2011) in slough areas subject to low DO levels did not encounter any green sturgeon. However, over the 30-year term of the SMP, it is reasonable to assume that a very small number of green sturgeon could be present during black water discharge events. NMFS estimates that no more than 5 green sturgeon will be harmed or killed by black water discharge events over the 30-year term of the SMP. Water quality PCEs of designated critical habitat for green sturgeon will be adversely affected by black water discharge events.

2. Fish Entrainment at Managed Pond Water Intakes.

Some water intakes in the marsh, primarily in Region 3, are equipped with fish screens. These screens were designed to exclude delta smelt and juvenile salmonids from entrainment and impingement. Placement of screens were prioritized in Region 3 because diversion sites within that area are located along the major migratory routes used by salmonids within the project area (Montezuma Slough and lower Suisun Slough). NMFS anticipates that no entrainment will occur at these screened diversion locations. However, not all diversions within the project area are screened. Listed adult Chinook salmon and steelhead are not expected to be entrained by unscreened diversions into managed wetlands because the swimming abilities of adult salmonids allow them to easily avoid entrainment in the gravity/tidal diversions utilized in Suisun Marsh. In addition, adult salmonids are migrating upstream and migratory cues such as attraction flows are not present at diversions. Similarly, adult and juvenile green sturgeon are not expected to be entrained by unscreened water diversions in Suisun Marsh. Green sturgeon are bottom oriented feeders and swimmers spending the majority of their time along channel bottoms. The level of intake pipes in the marsh is set so that they will operate at high tides, and this level is typically above the depth at which sturgeon will be expected. To assess fish losses to entrainment during water diversions into Suisun Marsh managed wetlands, CDFW performed fish sampling behind unscreened intakes in the marsh in the late 1990s and captured no adult salmonids or green sturgeon (SRCD and CDFW 2005).

Small numbers of salmonid smolts could be entrained through unscreened diversions into managed wetlands, particularly in September and October when high volume diversions occur. However, during this period, salmonid smolts are not likely to be abundant in the action area; unless early CV emigrants may be present. Sampling has documented small numbers of Chinook salmon smolts entrained during managed pond flood-up operations (DWR 2005, SRCD and CDFW 2005). During three sampling seasons CDFW conducted over 386 total sampling days with a total catch of 109 salmon. It should be noted that 103 of these fish were fall-run sized yoke fry that were washed down in a single high flow event (SRCD and CDFW 2005). Once diverted onto a managed wetland, water may be held for an extended period prior to draining. During residence on wetlands, water quality parameters may vary, creating conditions that may cause stress or mortality of entrained juvenile or smolting salmonids. Entrained salmonids may be exposed to increased predation rates within the managed pond. Thus, it is assumed that few, if any, salmonid smolts will survive in managed wetlands and eventually escape the impounded waters to complete their seaward migration.

To reduce entrainment of salmonids in unscreened diversions, the SRCD has proposed diversion curtailments. Complete and partial diversion gate closures are scheduled to coincide with the peak emigration periods of steelhead and Chinook salmon smolts between November 1 and May 31. At unscreened intakes, gate openings will be limited to 25 percent from November 1 through January 31. Between February 1 and February 21, diversion gates are not restricted, and entrainment of salmonid smolts may occur. Unscreened intakes will be completely closed from February 21 through March 31, and gate openings will range from 20 to 35 percent from April 1 to May 31. Limiting the size of the intakes' opening limits the area of the tidal slough that may be influenced by the "pull" of the diversion that fish must resist to avoid entrainment. The area of influence, where the effects of the diversion may be experienced by fish, corresponds to the size of the diversion pipe. When that pipe is closed to between 20 and 35 percent of its maximum extent, the area of influence is correspondingly smaller. Thus, the restrictions are expected to reduce entrainment because the diversions operated under the restrictions will affect a smaller fraction of the available tidal slough waters. In spite of the strong swimming abilities of salmonid smolts, diversion curtailments and restrictions may not prevent all entrainment. Juvenile steelhead have a longer freshwater rearing period, and emigrate at a larger body size than Chinook salmon. This larger body size imparts greater swimming abilities, and decreases the chance that a CCC steelhead or CV steelhead smolt will be entrained. This is supported by entrainment studies within Suisun Marsh that have encountered few Chinook salmon and no steelhead (SRCD and CDFW 2005). Small numbers of the portion of the smolt populations of winter-run Chinook salmon, CV spring-run Chinook salmon, CCC steelhead, and CV steelhead migrating through the action area may be entrained to unscreened diversion and lost to the population. Since all of the Chinook salmon observed during entrainment monitoring have been non-listed fall-run Chinook (SRCD and CDFW 2005), NMFS estimates that from 50 to 500 listed salmonid juveniles will be entrained and lost at unscreened diversions in Suisun Marsh over the 30-year term of the SMP.

3. Construction and Dredging Associated with RGP 3 Maintenance Activities.

Of the 29 maintenance activities proposed in RGP 3, 16 activities (described previously in *Proposed Actions*) will occur entirely within managed wetlands enclosed by perimeter levees. Reclamation and the Corps have determined these activities have no effect on listed salmonids or green sturgeon present in tidal waters outside the levees (Table 2). Since the federal action agencies have concluded these activities are "no effect" because they are conducted in areas isolated from tidal sloughs with listed fish and outside of designated critical habitat, these 16 maintenance activities are not discussed further in this biological opinion.

For 13 of the 29 maintenance activities proposed for authorization under RGP 3, the activities may affect listed salmonids, green sturgeon, or critical habitat. These activities are primarily repairs to exterior levees, shoreline stabilization, repair or replacement of water control structures, removal of debris, and repairs to existing facilities including fish screens and salinity monitoring stations.

Several best management practices are proposed for the above 13 RGP 3 activities which avoid or reduce potential impacts to tidal slough areas and listed fish. Work will only be conducted during low tide and not occur in-water. Repair or replacement of water control structures will generally be conducted from the levee crown and work is expected to be completed before the tide returns (within 6 to 8 hours). By conducting work in the dry, disturbance of sediments will result in only minimal turbidity. Fish will not be disturbed by construction equipment and activities as the site will be de-watered during low tide. Best management practices are also designed to avoid the introduction of sediments into the waters of the marsh and avoid impacts to existing vegetation. For the stabilization of shoreline and levee sites with the installation of brush boxes, some in-water work is expected, but it will be limited to hand work only. No heavy equipment will be used to install brush boxes. Once completed, brush boxes will capture sediment, provide habitat for emergent vegetation, and increase habitat quality for foraging and rearing salmonid smolts and juvenile green sturgeon. As a result, brush boxes are considered a beneficial alternative to traditional riprap and levee repairs. Based on the inclusion of the proposed best management practices, NMFS concurs with the Corps' determination that the above seven RGP 3 actions and the installation of brush boxes are not likely to adversely affect listed salmonids or green sturgeon.

Maintenance dredging and debris removal at fish screens and other facilities may affect listed salmonids or green sturgeon. However, these activities will be restricted to periods when sensitive salmonid species are not present and during periods of low tide. Dredging will occur around 17 fish screen structures within Suisun Marsh. Dredging around fish screens will be conducted with a long-reach excavator with a 0.5 or 1.0 cubic yard bucket, and is not expected to be necessary at each site annually. Dredge spoils will be placed on the inboard slope of exterior levees. Due to the very small volumes of material to be dredged at existing fish screens, a dredging episode to maintain a fish screen will be limited to a few hours around low tide. Suction dredging will not be used. Turbidity levels during dredging are expected to be minimal, temporary, and limited to the area immediately adjacent to the screen structures. As a result, the levels of turbidity expected are insignificant and discountable and thus not likely to adversely affect listed salmonids or green sturgeon. The excavator bucket size is small (0.5-1.0 cubic yard) and unlikely to capture listed fish during its operation. In combination with scheduling dredging episodes to periods when listed salmonids are not expected to be present, NMFS concurs that maintenance dredging at fish screens is not likely to adversely affect listed salmonids.

Because they are year-round residents in Suisun Marsh, some juvenile green sturgeon may be disturbed by maintenance dredging at fish screens. Suction dredging will not be used, and therefore, entrainment in the equipment will not occur. However, noise generated by the dredging operation will likely cause sturgeon to move out of the area. If green sturgeon react behaviorally to the sound produced by dredging, adequate water depths and carrying capacity in Suisun Marsh sloughs adjacent to maintenance sites will provide sufficient area for fish to temporarily disperse and sound from dredging is not be expected to result in more than an insignificant effect on them. These disturbances will be limited in number and geographic scope and temporary, and the behavioral response of green sturgeon is not expected to result in adverse effects to those sturgeon exposed.

Adverse effects to listed fish and critical habitat may occur during installation of riprap on exterior levees. The placement of riprap can result in the loss of soft-bottom intertidal habitat in areas with mudflats and emergent vegetation adjacent to perimeter levees. This conversion will result in a reduction of foraging and rearing habitat of salmonid smolts and green sturgeon in Suisun Marsh. These changes are likely to be minor in spatial aspect, as most sites will be the placement of rock to replace missing riprap. However, up to 200 linear feet of new riprap may be placed annually on the external sides of levees. Emergent vegetation will be lost in some areas, but may become reestablished in the interstices of the riprap. Emergent vegetation provides a source of allochthonous prey and provides cover and protection from visual predators. To minimize impacts during placement of the riprap, the applicant will conduct the work at low tide when most or all of the work area is exposed, negating the need to place riprap in water. Riprap placed on exterior levees in Suisun Marsh has generally been placed in areas with maximal tidal exchange and erosive forces. If the existing riprap is damaged or lost and not replaced, unprotected soils in the levees will be exposed to those erosive forces. These damaged areas, if not repaired, will likely lead to additional levee scour introducing more fine sediments and will negatively affect constituent elements of salmonid and sturgeon habitat, thereby, adversely affect ESA-listed fish in the area. The amount of lost emergent vegetation due to placement of rock riprap is expected to be small. However, the project will be maintaining the existing degraded condition of shoreline habitat adjacent to levees in Suisun Marsh.

Installation of new exterior drain structures could adversely affect listed species by leading to increased areas with poor water quality due to the discharge of black water. NMFS anticipates that satisfactory best management practices will be used during construction to adequately minimize or eliminate sediment and contaminant input from construction-related activities. However, if a new drain structure is installed in a location with poor tidal circulation, drain water could contribute to poor water quality. As described in *Managed Wetland Operations*, degraded water quality has occurred and may adversely affect CCC steelhead smolts and juvenile green sturgeon. The potential effects of degraded water quality and black water events are discussed above in Section V.A.1. Installation of new exterior drain structures could adversely affect listed species if a structure is installed in a location with poor tidal circulation. However, the SRCD is coordinating closely with landowners to ensure that new drain structures are not placed where black water conditions are likely to occur. Based on SRCD's technical assistance, NMFS anticipates the future operation of new drain structures will not result in discharges that cause low dissolved oxygen levels in the tidal sloughs of the action area.

B. Maintenance Dredging Actions

Under the proposed Corps-issued LOP, landowners within Suisun Marsh may conduct dredging from tidal sloughs adjacent to exterior levees for the purpose of collecting material to place on the levees. This form of levee maintenance has not been conducted in Suisun Marsh since 1994. With the use of a long-reach excavator or clamshell dredge, materials will be collected and placed on the levee crown to repair existing structures.   Although ESA-listed anadromous salmonids migrate seasonally through the action area, the LOP will restrict dredging activities to the period of August through November. This schedule avoids the migration periods of all ESA-listed anadromous salmonids. Thus, NMFS anticipates no ESA-listed salmonids will be present in the action area during dredging activities and, therefore, will not be subjected to the temporary effects of degraded water quality.

For threatened green sturgeon, dredging activities associated repair and/or maintenance of levees may have temporary effects on water quality. Dredging is expected to disturb shoreline and bottom sediments which could generate increased levels of turbidity within the adjacent water column. Increased levels of turbidity can affect fish species by disrupting normal feeding behavior, reducing growth rates, increasing stress levels, and reducing respiratory functions. (Benfield and Minello 1996, Nightingale and Simenstad 2001). However, this type of dredging with a long-reach excavator or clamshell dredge typically results in short-term and localized levels of increased turbidity. Plumes of fine sediment from clamshell dredging operations at the Oakland Outer Harbor displayed rapidly decaying concentrations of suspended sediment with time and distance from the source of disturbance (Clarke *et al.* 2005). Minor and localized elevated levels of turbidity associated with dredging activities are expected to quickly disperse with the area's tidal circulation. As a benthic dwelling species, green sturgeon are adapted to living in estuaries with fine sediment bottoms and, thus, are tolerant of high levels of turbidity; specifically, they are tolerant of levels of turbidity that exceed levels expected to result from this project. Therefore, elevated levels of turbidity associated with dredging for levee maintenance are expected to be considerably lower than the thresholds commonly cited as the cause of the above possible behavioral and physical impacts. With regard to this project, impacts to water quality are expected to be insignificant for threatened green sturgeon.

Entrainment or physical injury of green sturgeon by mechanical dredging equipment is not expected to occur, because dredge buckets will be relatively small (less than 12 cubic yards), and green sturgeon are large and powerful swimmers capable of fleeing the area upon commencement of dredging operations. While this in-water activity may startle green sturgeon in the project vicinity, the behavioral response of temporarily leaving the site is not expected rise to a level of adverse effect because it will be of a very short duration and waterways adjacent to the project sites offer ample areas for fish to avoid the area of disturbance. Therefore, the potential for entrainment is discountable and the effects of disturbance during levee maintenance are not expected to rise to levels that will adversely affect green sturgeon.

Upon completion of dredging, edgewater habitat adjacent to the shoreline will be disturbed. Emergent vegetation could be lost and aquatic invertebrates removed with bottom sediments. Existing edgewater habitat in these channels has been altered by the construction of the levee system and past dredging for levee maintenance. Thus, the existing shoreline areas along tidal sloughs are important habitat for fish foraging and cover. Dredging within the wetted portions of the action area has the potential to displace existing shallow water aquatic invertebrates. This may affect green sturgeon and listed anadromous salmonids by temporarily reducing the abundance of intertidal and subtidal prey species. Juvenile green sturgeon likely forage on benthic crustaceans, clams, crabs, annelid worms, and other fishes (Ganssle 1966) in the action area. However, this project's disturbance of the benthic faunal community is not expected to substantially influence the foraging behavior or prey abundance of green sturgeon or salmonids, because of the infrequent and short extent of these dredging activities. Furthermore, some aquatic invertebrates are known to rapidly re-colonize disturbed areas (Collier *et al*. 2000) and the invertebrate community will likely be re-established within one year. If dredging activities result in reduced prey availability, green sturgeon and juvenile salmonids are expected to continue their foraging activities and migration to areas where prey is readily available. However, project impacts to the benthic faunal community are expected due to the potential large amount of material removed annually (up to 100, 000 cubic yards) and the length of shoreline areas affected. Vegetation lost to dredging will reduce habitat complexity, reduce primary production, and eliminate areas of cover for listed fish. The ability for some benthic organisms and vegetation to rapidly re-colonize disturbed sites may reduce the level of impact and impacts will typically be limited to targeted repairs areas spread throughout the 116,000 acre action area.

C. Wetland Restoration

Project construction involves the excavation of sediments, sculpting of local topography, and breaching of levees. Construction activities within the existing perimeter levees will not affect ESA-listed fish or habitat, because the project area will remain isolated from tidal sloughs. With the breaching of the perimeter levees, the initial circulation of tidal waters through the restoration site may affect ESA-listed fish through the discharge of sediment. However, all constructed breaches of perimeter levees will be restricted to the period between August 1 and November 30 to avoid the migration season of listed salmonids. Thus, adult and juvenile salmonids will not be affected by levee breaching at tidal wetland restoration sites. Once completed, the restored marsh is expected to benefit salmonids by increasing the amount of foraging habitat and increasing the amount of brackish habitat for individuals undergoing parr-smolt transformation.

Since juvenile green sturgeon use estuarine waters year-round, they may be in the area during the proposed breaching activities and be exposed to breaching-related effects. Restoration projects will incorporated measures to minimize and control project-related sedimentation for breaching activities, including a stormwater pollution prevention plan, compliance monitoring, and emergency response actions. No resulting discharges from the site will exceed threshold limitations set by the California Regional Water Quality Control Board.

The soils within Suisun Marsh are various silty loams, though some areas are dominated by peat soils. Observations during breaching at the Napa Salt Plant wetland restoration site (a site with the similar soil types), showed that these soils are very cohesive. Soils at the Napa salt Plant wetland restoration site did not exhibit dispersive properties when excavated and subsequently inundated after levee breaching. The construction methods and sediment control measures utilized at the neighboring site proved sufficient to prevent turbidity plumes from entering receiving waters. SMP wetland restoration projects propose to utilize the same techniques to avoid degradation of water quality during breaching events. Therefore, increased turbidity levels associated with construction and breaching events are expected to be localized and short-term in duration. As a benthic dwelling species, green sturgeon are adapted to living in estuaries with fine sediment bottoms and, thus, are tolerant of high levels of turbidity. Green sturgeon in the San Pablo Bay estuary commonly encounter areas of increased turbidity due to storm flow runoff events, wind and wave action, and benthic foraging activities of other aquatic organisms. Therefore, any short-term impact associated with turbidity during implementation of this project is expected to be insignificant for green sturgeon.

Once completed, wetland restoration is expected to benefit designated critical habitat for green sturgeon and winter-run Chinook salmon by increasing the amount of tidal marshland in Suisun Marsh by 5,000 to 7,000 acres. Over time, levee breaches and the restoration of tidal action will create a network of intertidal channels extending out into the marsh plain from constructed pilot channels. NMFS anticipates improvements to water quality and increased foraging opportunities for green sturgeon and salmonids as implementation of the SMP proceeds over the 30-year term. With the project's requirement to meet tidal restoration acreage targets at 10-year intervals, the habitat benefits of the SMP are ensured to accrue.

Overall, the anticipated adverse effects to habitat from the SMP activities are expected to generally be of short duration, infrequent intervals, and to impact small areas at any one time. Proposed maintenance activities will maintain the current altered condition on perimeter levees and the adjacent sloughs. However, restoration of 5,000 to 7,000 acres of tidal wetland habitat is expected to improve the quantity and quality of estuarine habitat in Suisun Marsh for listed fish, including designated critical habitat for winter-run Chinook salmon and green sturgeon.

VII. CUMULATIVE EFFECTS

Cumulative effects are defined in 50 § CFR 402.02 as "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." Future Federal actions, including the ongoing operation of dams, hatcheries, fisheries, water withdrawals, and land management activities will be reviewed through separate section 7 consultation processes and are not considered here. Non Federal actions that require authorization under section 10 of the ESA, and that are not included within the scope of this consultation, will be evaluated in separate section 7 consultations and are not considered here. NMFS is not aware of any future State or private activities that are reasonably certain to occur within the action area, other than those analyzed above resulting from interrelated and interdependent activities and climate change.

Climate change poses a threat to salmonids and green sturgeon within the action area during and after the 30 year proposed action. In the San Francisco Bay region, extreme 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). Interior portions of San Francisco Bay are forecasted to experience a threefold increase in the frequency of hot daytime and nighttime temperatures (heat waves) from the historical period (Cayan *et al.* 2012). Climate simulation models also project that the San Francisco region will maintain its Mediterranean climate regime, but experience a higher degree of variability of annual precipitation during the next 50 years and years that are drier than the historical annual average during the middle and end of the twenty-first century. The greatest reduction in precipitation is forecasted to occur in March and April, with the core winter months remaining relatively unchanged (Cayan *et al.* 2012). The current climate in the San Francisco Bay region is generally warm, and modeled regional average air temperatures show an increase in summer (Lindley *et al.* 2007) and greater heat waves (Hayhoe *et al.* 2004) under climate change scenarios. Cloern *et al.* (2011) projects that the salinity in San Francisco Bay could increase by 0.30-0.45 practical salinity unit (psu) per decade due to the confounding effects of decreasing freshwater inflow and sea level rise (projected by Cloern *et al.* 2011 to rise approximately 4 inches per decade). Sea level rise under this and other scenarios (See, for example, Cayan *et al.* 2012, BCDC 2013) could change result in changes to the remaining un-diked marshes in Suisun Marsh by mid Century. For example depths may increase and saltgrass (*Distichlis spicata*) may decrease (BCDC 2013).

VIII. INTEGRATION AND SYNTHESIS OF EFFECTS

Water operations for managed wetlands in Suisun Marsh during the next 30 years are expected to adversely affect listed salmonids and green sturgeon by degrading water quality from drainage off managed wetlands, and by entrainment during diversions into managed wetlands. CCC steelhead smolts and juvenile green sturgeon that may be present in the small dead-end sloughs of Region 1are the most likely listed fish species under the jurisdiction of NMFS that could be exposed to low dissolved oxygen conditions during black water discharge events. CCC steelhead smolts may be exposed during May and June, and juvenile green sturgeon may be exposed during May, June, and October to black water events. Low dissolved oxygen levels in these marsh areas during black water discharges could result in fish mortality. Although NMFS does not anticipate many CCC steelhead or green sturgeon to be in the areas of poor water conditions, any CCC steelhead or green sturgeon that do encounter areas with degraded water quality conditions from which they cannot escape, will experience adverse effects, that may include death. Mortalities of green sturgeon and CCC steelhead smolts are anticipated to be uncommon and will not occur every year. NMFS estimates that no more than 5 green sturgeon and no more than 20 CCC steelhead smolts will be harmed or killed by black water discharge events over the 30-year term of the SMP. The migratory pathways of winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, and spawning adult green sturgeon occur south of Suisun Marsh Region 1, and they are unlikely to experience the adverse effects of poor water quality associated with black water discharges.

Listed salmonid smolts may be entrained through unscreened diversions into managed wetlands. Once diverted onto a managed wetland, it is assumed that few, if any, fish will escape the impounded waters. Several intakes along major migratory routes are equipped with fish screens and no losses to entrainment are expected at these locations. However, at unscreened diversion sites, salmonid smolts may be entrained, but the numbers are expected to be very small. Central Valley salmonids, both Chinook and steelhead, migrate primarily along Montezuma Slough in Region 3, where screened intakes prevent entrainment. CCC steelhead smolts originating from Suisun and Green Valley creeks do not pass through most of Region 1, or through any part of Regions 2, 3, or 4, and will not be exposed to potential entrainment in most of the action area. In addition, steelhead smolts are larger than Chinook salmon smolts and their better swimming ability will allow them to generally avoid entrainment at gravity operated diversions. When combined with the proposed diversion curtailments from November through May, it is expected that a very small number of juvenile steelhead or Chinook salmon will be entrained at unscreened diversions in Suisun Marsh. Since all of the Chinook salmon observed during entrainment monitoring have been non-listed fall-run Chinook (SRCD and CDFW 2005), NMFS estimates that from 50 to 500 listed salmonid juveniles will be entrained and lost at unscreened diversions in Suisun Marsh over the 30-year term of the SMP.

Thirty different maintenance and operations actions are proposed for authorization under RGP 3 and the LOP. Of the 30 proposed actions, 16 are expected to have no effect on listed species. With the implementation of proposed best management practices, most of the remaining actions are not likely to adversely affect listed species. These actions consist of repair and replacement of water control structures, debris removal, and repairs at existing fish screens, gages, and monitoring stations. These maintenance activities are primarily performed at low tide and, thus, equipment and personnel are not working within tidal waters of Suisun Marsh sloughs. They are generally separated from each other in space and time, over the entire 116,000 acres of the action area, and effects are minimal, localized, and temporary. It is unlikely that combined effects of these maintenance activities will rise to the level of adversely affecting listed and proposed species.

Under RGP 3, replacement of existing riprap on exterior levees and installation of new riprap are expected to adversely listed anadromous salmonids, green sturgeon, and designated critical habitat. Riprap placement can result in the loss of intertidal habitat, including emergent vegetation and benthic organisms living in soft substrate areas. Riprap use will generally occur in areas where riprap was previously placed, which limits the potential loss of existing shoreline habitat. However, landowner maintenance of levees and shoreline areas with riprap will continue to maintain the existing degraded condition of shoreline habitat in the action area and constrain the development of tidal marsh areas along slough margins.

Under the LOP, materials may be dredged from tidal waters for the purpose of maintaining and repairing levees. Dredging may result in increased levels of turbidity in the vicinity of the work site during dredging. Excavators or clamshell dredge operations will be restricted to the period between August and November. This period avoids the migration periods of listed anadromous salmonids in the action area and few green sturgeon are expected to be present at or in close proximity to dredge sites during dredging activities. Anticipated turbidity levels are not expected to result in harm or injury, or behavioral responses that impair migration, foraging, or make green sturgeon more susceptible to predation. However, the removal of sediments during dredging is anticipated to adversely affect shoreline habitat areas by removing vegetation and removing benthic macroinvertebrates. Loss of these prey organisms will reduce foraging opportunities for salmonids and sturgeon, and could contribute to an overall decline in nearshore productivity.

Based on the above, a small number of juvenile, sub-adult, and adult green sturgeon, and adult and smolt CCC steelhead, CV steelhead, CV spring-run Chinook, and Sacramento River winter-run Chinook are expected to be adversely affected by the Project's proposed placement of rock riprap, operation of water control structures, and dredging activities. Therefore, it is unlikely that the small potential loss of individuals as a result of the project will impact future adult returns, due to the large number of individual green sturgeon and salmonids unaffected by the project compared to the small number of green sturgeon and salmonids likely affected by the project.

Due to the life history strategy of green sturgeon which spawn every 3-5 years over an adult lifespan of as much as 40 years (Moyle 2002), the few individuals injured or killed by exposure to black water discharges are likely to be replaced in subsequent generations of green sturgeon. Similarly, due to the relatively large number of juveniles produced by each spawning pair, juvenile salmonids lost to black water events and entrained at managed pond water intakes in future years are expected to produce enough juveniles to replace the small number of individuals injured or killed. It is unlikely that the small potential loss of juveniles by the SMP over the 30-year permit term will impact future adult returns.

Potential impacts to winter-run Chinook salmon and southern DPS green sturgeon critical habitat are not expected to appreciably diminish the capability of the action area to provide PCEs for these species. The existing condition of fish habitat in Suisun Marsh has been influenced by a long history of human disturbance, including diking and draining of marshes for waterfowl and recreational hunting. Currently the action area consists of mostly diked brackish marshes and managed waterfowl ponds that are inaccessible to fish. The existing condition of PCEs in the action area is degraded. In the action area, replacement of existing riprap will continue to maintain the existing degraded condition of shoreline habitat along the tidal sloughs of Suisun Marsh. Installation of new riprap will result in the loss intertidal mudflats and emergent vegetation. Although habitat values in erosive areas are likely to be low, habitat elements that have developed will be lost during replacement. Mudflats are inhabited by a diverse assemblage of benthic infauna and epifauna (organisms living in and on the sediments), and serve as important feeding and rearing areas for listed salmonids and green sturgeon. Vegetation also provides a source of prey from insects that drop from plants, and provides cover and protection from visual predators. Best management practices limit work to low tides, and require the use of the minimum amount of rip rap required.

Over the 30-year term of the SMP, 5,000 to 7,000 acres within the action area will be restored to tidal marsh. This component of the SMP is anticipated to provide significant long-term benefits to winter-run Chinook salmon and green sturgeon critical habitat in the action area. Over time, levee breaches and the restoration of tidal action will create a network of intertidal channels extending out into the marsh plain from constructed pilot channels. The expected levels of disturbance from construction activities on designated critical habitat will be minor, short-term, and localized. NMFS anticipates that these effects will be insignificant to the functioning of designated critical habitat. Tidal marsh restoration and expansion are anticipated to be benefit critical habitat by providing increases in habitat areas, prey base, foraging areas, and cover/shelter areas. Overall, the proposed 5,000 to 7,000 acres of tidal wetland restoration are expected to result in long-term beneficial effects to designated critical habitat, by expanding tidal marsh habitat in Suisun Marsh.

Some of the projected impacts from climate change described in *Status of the Species and Critical Habitat* section of this biological opinion are likely to be realized in the San Francisco Bay Region, including the action area, within the 30-year duration of the SMP. Water temperatures are likely to warm, overall flows may decline (especially in the spring), extreme weather events are likely to increase, and sea levels are likely to continue to rise. NMFS expects that the effects of climate change are unlikely to increase the adverse effects of the proposed action because the timing, duration, or locations of these adverse effects do not match up with climate change in ways likely to magnify the effects of the action. For example, a very small number of salmonid smolts may be entrained by managed wetland operations during the proposed action. However, most managed wetlands along main salmonid migration routes are screened, preventing entrainment. In addition, during the spring when water levels are lowering in the marsh, making entrainment more likely, diversions are curtailed or restricted. Low dissolved oxygen events from black water discharges that currently impact listed salmonids and green sturgeon may be less frequent as sea levels rise and expose more of Suisun Marsh to more vigorous tidal action. Restored wetlands in the marsh will be designed to retain their intended function in the face of sea level rise and other projected changes (*i.e.*, salinity changes). Restored tidal marsh is expected to enhance habitat values for listed salmonids, green sturgeon, and critical habitat as nearshore and wetland environments are significant expanded. Climate change in 30 years may begin to reduce species viability and the conservation value of critical habitat throughout each ESU and DPS. However, the SMP's long-term benefits from the restoration of tidal wetlands are expected to provide listed anadromous salmonids and green sturgeon some increased resistance to climate change.

IX. CONCLUSION

After reviewing the best available scientific and commercial data, the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' biological opinion that the 30-year SMP proposed to be authorized by the Corps and partially funded by Reclamation are not likely to jeopardize the continued existence of endangered Sacramento River winter-run Chinook salmon, threatened CV spring-run Chinook salmon, threatened CCC steelhead, threatened CV steelhead, or threatened Southern DPS of North American green sturgeon.

After reviewing the best available scientific and commercial data, the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' opinion that the SMP activities proposed to be permitted by the Corps and partially funded by Reclamation are not likely to adversely modify or destroy critical habitat for Sacramento River winter-run Chinook salmon or southern DPS green sturgeon.

X. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without 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 NMFS as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken by the Corps, Reclamation, and the applicants for the exemption in section 7(o)(2) to apply to listed steelhead, Chinook salmon, and green sturgeon. The Corps and Reclamation have a continuing duty to regulate the activity covered by this incidental take statement. If the Corps, Reclamation, and the applicants: (1) fail to assume and implement the terms and conditions, or (2) fail to require any permittee to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to any permit, grant document, or contract, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps and the applicants must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

A. Amount or Extent of Take

Listed anadromous salmonid smolts and green sturgeon may be harmed or killed by managed wetland operations in Suisun Marsh. Water operations for managed wetlands are anticipated to entrain juvenile listed anadromous salmonid smolts over the 30-year term of the SPM. Black water discharges with extremely low dissolved oxygen levels during May, June and October in Region 1 could expose listed salmonid smolts and juvenile green sturgeon to low dissolved oxygen levels resulting in fish mortality over the 30-year term of the SMP.

The numbers of listed anadromous salmonids entrained at unscreened diversion cannot be accurately estimated because (1) the precise number of fish that may be present is unknown; (2) the precise number of fish that may be entrained is unknown; and (3) the precise level of harm or mortality that might occur when fish are entrained is unknown. However, the number of affected salmonids is expected to be small (between 50 and 500 juvenile salmonids over the 30-year term of the SMP) because the unscreened diversions are located in areas away from commonly used migration corridors and proposed diversion restrictions reduce the intake water velocities.

The numbers of listed anadromous salmonids and green sturgeon killed or harmed by poor water quality cannot be precisely calculated because (1) the precise number of fish that may be present is unknown; (2) the precise number of fish that may be exposed to degraded water quality is unknown; and (3) the precise level of harm or mortality that might occur when smolting steelhead or juvenile green sturgeon are exposed to degraded water conditions is unknown. However, the number of affected steelhead and sturgeon are expected to be very small (up to 20 CCC steelhead and 5 green sturgeon over the 30-year term of the SMP) due to the limited extent, duration, and location of the black water events.

B. Effect of the Take

In the accompanying biological opinion, NMFS has determined that the anticipated take is not likely to result in jeopardy to CCC steelhead, CV steelhead, CV spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, and southern DPS green sturgeon.

C. Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of winter-run Chinook salmon, CV spring-run Chinook salmon, CCC steelhead, CV steelhead, and southern DPS of North American green sturgeon:

1. The Corps, Reclamation, and SRCD must undertake measures to minimize harm to listed salmonids and green sturgeon resulting from work on exterior levees.

2. The Corps, Reclamation, and SRCD must undertake measures to ensure tidal wetland restoration projects implemented by the SMP are designed to avoid and minimize harm to listed salmonids and green sturgeon during construction, and provide long-term benefits to listed fish and critical habitat.

3. The Corps, Reclamation and SRCD must monitor and report: (1) degradation of ambient water quality from drain water, (2) potential entrainment of listed species at unscreened water diversions, and (3) effects of project activities and project performance.

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Corps, Reclamation, and the applicants must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

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

    a. The NMFS Santa Rosa Area Office, must be notified by letter or email message stating the project commencement date, at least 14 days prior to implementation.

    b. NMFS employee(s) or any other person(s) designated by NMFS must be allowed access to SMP work sites to accompany field personnel during activities described in this opinion.

    c. A biologist or on-site monitor must evaluate each site during project implementation to document project actions for the purpose of identifying any condition that could adversely affect salmonids, green sturgeon, or their habitat. Whenever conditions are identified that could adversely affect salmonids, green sturgeon, or their habitat, in a manner not described in this opinion, NMFS shall be immediately notified by contacting biologist Daniel Logan at (707) 575-6053 or dan.logan@noaa.gov.

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

    a. For each proposed tidal wetland restoration project, draft project-specific restoration design plans (65-90 percent design level) must be submitted to NMFS for review and written approval at least 120 days prior to initiation of construction.

b. The draft project plans for each tidal wetland restoration project shall be submitted to: NMFS Santa Rosa Area Office Attention: Supervisor of Protected Resources Division, 777 Sonoma Avenue, Room 325, Santa Rosa, California, 95404-6528.

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

   a. Water quality in tidal sloughs must be monitored to assess the effects of drain water in receiving sloughs. This monitoring shall target detection of low dissolved oxygen conditions in May, June and October in Region 1 of Suisun Marsh (see figure 1 in attached biological opinion).

   b. Written annual reports must be provided to NMFS by December 31 of each year. The report shall be submitted to the NMFS Santa Rosa Area Office Attention: Supervisor of Protected Resources Division, 777 Sonoma Avenue, Room 325, Santa Rosa, California, 95404-6528. The report shall contain, at a minimum, the following information:

      i. **Project related activities –** The report must include the type, size, and location of each specific action undertaken under RGP 3 and the LOP within tidal water areas and on exterior levees. Reports shall include the following information for each activity: dates specific actions began and were completed; a description of best management practices (i.e., BMPs) implemented to minimize project effects; photographs taken before, during, and after the activity from photo reference points; and a discussion of specific project performance or efficacy

      ii. **Water quality** - The report must summarize the results of the water quality monitoring and evaluate wetland management operational modifications utilized. Any observations of fish kills occurring within Suisun Marsh must be reported

      iii. **Gate closures and diversion curtailment** - The report must summarize the compliance monitoring for gate closures and diversion curtailments.

      iv. **Tidal wetland restoration** - The report must summarize planning and implementation of tidal wetland restoration actions by the SMP.

XI. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, or develop additional information.

NMFS offers the following Conservation Recommendation:

1. The Corps, Reclamation, CDFW, and the SRCD continue to pursue management options, including vegetation management and diversion timing and location, to avoid and minimize occurrence of black water conditions in managed wetlands. The Corps, Reclamation, CDFW, and the SRCD should participate in a study designed to determine how juvenile salmonids and green sturgeon use the Suisun Marsh during rearing or migration to and from the ocean. The Corps, Reclamation, CDFW, and the SRCD should coordinate with NMFS to ensure that information gathered by these and other entities will provide information to aid in determining the use of Suisun Bay by juvenile salmonids and sturgeon. Potential areas to place monitors include mouths of significant sloughs, the downstream end of Montezuma Slough, the center of Suisun Bay mudflats, and sites of significant unscreened diversions.

2. The Corps, Reclamation, CDFW, and the SRCD should monitor fish entrain behind unscreened water intakes at managed ponds within Suisun Marsh. Study plans should be provided to NMFS for review and comment prior to implementation.

XII. REINITIATION NOTICE

As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to 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 identified action. In instances where the amount or extent of incidental take is exceeded, formal consultation must be reinitiated immediately.

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Appendix: Figures and Tables

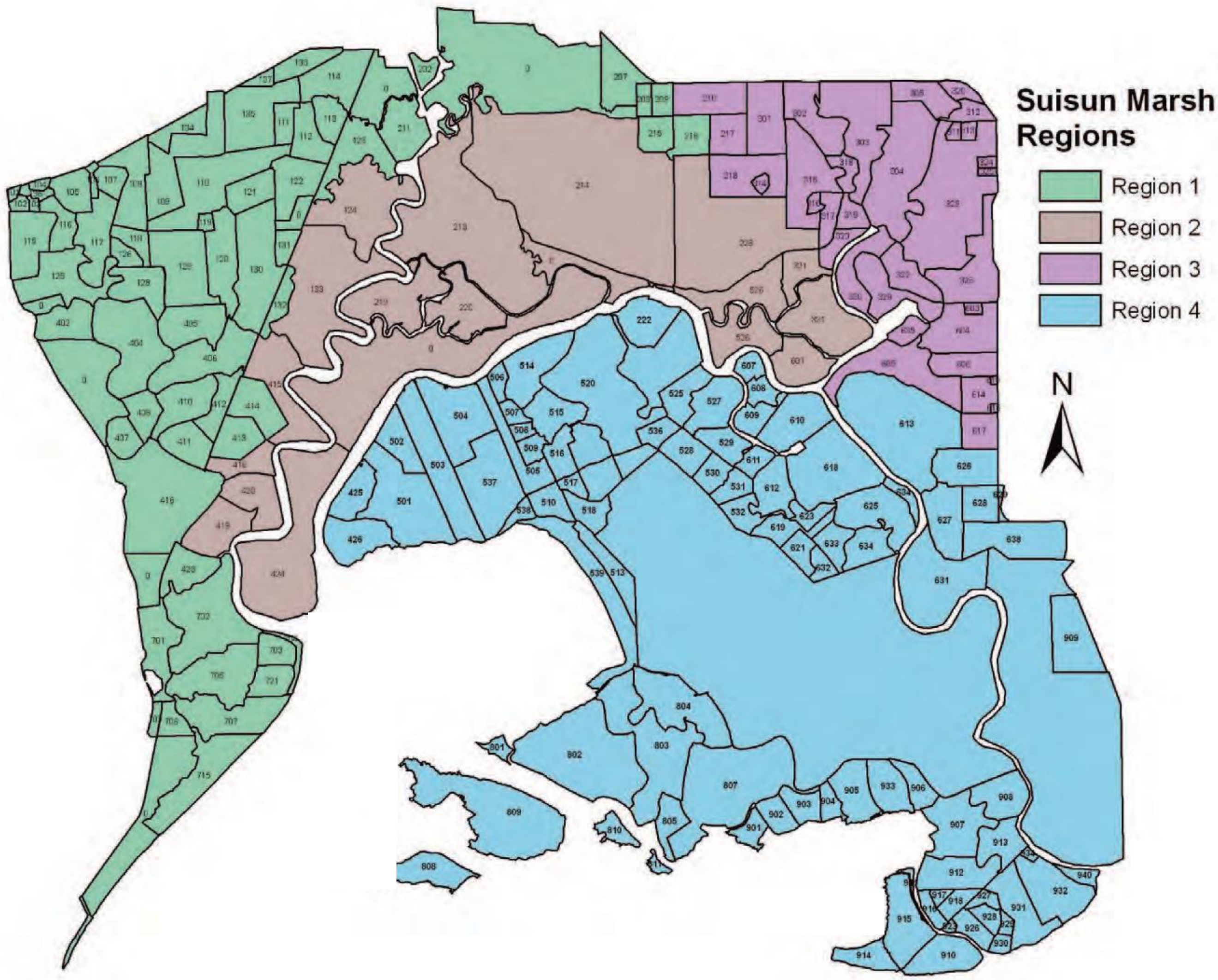

Figure 1. Suisun Marsh, with regions and major sloughs identified. Solano County, California.

Table 1. The seasonal presence of several species by life history stage during the proposed operations and maintenance activities on managed wetlands in Suisun Marsh. Presence of Sacramento River winter-run Chinook salmon (SRWR), Central Valley spring-run Chinook salmon (CVSP), Central Valley steelhead (CVSh), CCC steelhead (CCCSh), and southern green sturgeon (SGS) is denoted with an "X", and periods of peak presence in the marsh are in bold type "**X**".

Activity	Flood-up	Circulation (diversion restrictions – Nov 1-waterfowl season)	Circulation (diversion restrictions - waterfowl season)	Circulation (diversion restrictions - waterfowl season)	Flood-up (diversion curtailments – Feb 21- Mar 31)	Leech Cycles (diversion curtailments – Feb 21- Mar 31)	Leech Cycles - drain (diversion restrictions – April 1-May 31)	Leech Cycles – fill (diversion restrictions – April 1-May 31)	Drain	Dry – Maintenance Activities		Maintenance Activities and Flood -up
	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sep
SRWR Adult		X	**X**	**X**	**X**	X						
Juvenile		X	X	**X**	**X**	**X**	X	X				
CVSR Adult			X	**X**	**X**	**X**	X					
Juvenile			X	X	X	**X**	**X**	**X**	X			
CVSh Adult		X	X	**X**	**X**	X	X					
Juvenile					X	X	**X**	**X**	X			
CCCSh Adult			X	**X**	**X**	X	X					
Juvenile					X	X	**X**	**X**	X			
SGS Adult					X	**X**	**X**	X	X			
Juvenile	X	X	X	X	X	X	X	X	X	X	X	X

Table 1. Principal agencies and charter agencies and regulatory actions related to the Suisun Marsh Plan. [Source: Reclamation 2012, Table 1.][9]

Activities	Principal Agencies							Charter Agencies		
	USFWS	**Reclamation**	**CDFW**	**DWR**	**SRCD**	**NMFS**	**CalFed/ CBDA/DSC**	**Corps**	**BCDC**	**RWQCB**
Tidal Restoration	NEPA Lead Programmatic BO	NEPA Lead	CEQA Lead	CEQA Responsible	N/A	BO	Science Integration	Individual Permit	Coastal Consistency Determination	401 Water Quality Certification
Managed Wetland Activities	BO	NEPA Lead	CEQA Lead CESA Permit	CEQA Responsible	CEQA Responsible	BO	N/A	Regional General Permit Letter of Permission	N/A	401 Water Quality Certification
Preservation Agreement Implementation Fund	BO	NEPA Lead	CEQA Lead	CEQA Responsible	CEQA Responsible	BO	N/A	Regional General Permit	N/A	N/A

BCDC = Bay Conservation and Development Commission.
BO = biological opinion.
CALFED = CALFED Bay-Delta Program.
CBDA = California Bay-Delta Authority.
CEQA = California Environmental Quality Act.
CESA = California Endangered Species Act.
Corps = U.S. Army Corps of Engineers.
CDFW = California Department of Fish and Wildlife.
DSC = Delta Stewardship Council.
DWR = California Department of Water Resources.
N/A = not applicable.
NEPA = National Environmental Policy Act.
NMFS = National Marine Fisheries Service.
PAI = Preservation Agreement Implementation.
Reclamation = Bureau of Reclamation.
RWQCB = San Francisco Regional Water Quality Control Board.
SRCD = Suisun Resource Conservation District.
USFWS = U.S. Fish and Wildlife Service.

[9] These actions are for the SMP, lead agencies for subsequent tidal restoration planning efforts will depend on project proponents

Table 2. List of proposed maintenance activities for managed wetland within the Suisun Marsh Plan to be authorized using RGP 3, a determination as to whether or not the activity may affect ESA-listed species and critical habitat, and whether or not the activity is new to this RGP 3. [Source: Reclamation 2012, Tables 5a, 5b, 9, & 10.]

#	Activity	May Affect?	New
1	Repair existing interior levees	No	No
2	Core existing interior levees	No	No
3	Grade pond bottoms for water circulation	No	No
4	Create pond bottom spreader V-ditches	No	No
5	Install or repair existing interior water control structures, including interior bulkheads	No	No
6	Replace pipe for existing interior water control structures or install new interior water control structures	No	No
7	Install new blinds and relocate, replace, or remove existing blinds	No	No
8	Disc managed wetlands	No	No
9	Install drain pumps and platforms	No	No
10	Replace riprap on interior levees	No	No
11	Remove floating debris from pipes, trash racks, and other interior structures	No	No
12	Install alternative bank protection such as brush boxes, biotechnical wave dissipaters, and vegetation on interior levees and interior side of exterior levees	No	No
13	Construct cofferdams in managed wetlands (considered interior activity because it is in the managed wetlands)	No	No
14	Construct new interior ditch; clear existing interior ditches	No	No
15	Placement of new riprap on interior levees and interior side of exterior levees	No	Yes
16	Constructing new interior levees for improved water control and habitat management in the managed wetland	No	Yes
17	Repair existing exterior levees, including coring	Yes	No
18	Replace riprap on exterior levees	Yes	No
19	Repair exterior water control structures (gates, couplers, and risers)	Yes	No
20	Install or replace pipe for existing exterior flood, drain, or dual-purpose gate	Yes	No
21	Install, repair, or re-install exterior water control bulkheads	Yes	No
22	Remove floating debris from pipes, trash racks, and other exterior structures	Yes	No
23	Install alternative bank protection such as brush boxes, biotechnical wave dissipaters, and vegetation on exterior side of exterior levees	Yes	No
24	Repair and maintain Suisun Marsh salinity control gate	Yes	No
25	Clean Roaring River Distribution System fish screen	Yes	No
26	Install new fish screen facilities	Yes	No
27	Repair or replace salinity monitoring station	Yes	No
28	Relocate, install, or remove salinity station	Yes	No
29	Placement of new riprap on exterior levees	Yes	Yes

Table 3. List of proposed maintenance activities for managed wetlands for which there is a potential to affect ESA-listed anadromous fish or critical habitat and best management practices to avoid or minimize potential project-related effects. [Source: Reclamation (2012).]

	Activity	Best Management Practices
17	Repair exterior existing levees, including coring	• No in-water work. • Emergent vegetation not disturbed. • All material shall remain on the crown or interior side of the levee. • Levee repair not done in the rain. • Dredging from tidal sloughs for levee maintenance is not permitted. [covered under the 10-year LOP.] • Excavated material from coring remains on the crown of the levee.
18	Replace existing riprap on exterior levee	• Riprap only placed where previously existing rip-rap was present. • Riprap is replaced in the minimum amount necessary. • Riprap not placed on emergent vegetation. • Riprap is placed during low tide.
19	Repair, replacement, or installation of exterior water control structures (gates, stubs and couplers)	• All work done at low tide. • In-water work done by hand. • Maintenance will not change the existing use or diversion capacity. • Fish screens will be installed on any new or enlarged water control structures.
20	Pipe replacement for existing exterior flood, drain, or dual-purpose gate	• No in-water work. • All work done at low tide. • New pipe pre-assembled before installation. • Pipe placed below depth of emergent vegetation. • Pipe replacement is not done in the rain. • Replacement will not change the existing use or diversion capacity. • New drain is installed where exterior levees have no emergent vegetation.
21	Install, repair, or re-install exterior water control bulkheads	• No in-water work. • No excavation of sediments from exterior slough. • All bulkheads will be in place prior to backfilling the bulkhead during installation, repair, or re-installation of water control structures.
22	Remove floating debris from pipes, trash racks, and other exterior structures	• Material is disposed of outside the Marsh. • Work is done annually, generally during the summer months.
23	Install alternative bank protection such as brush boxes, biotechnical wave dissipaters, and vegetation on exterior side of exterior levees	• No in-water work. • All work done at low tide. • Work is done entirely by hand.
24	Repair and maintain Suisun Marsh salinity control gate	•
25	Clean Roaring River Distribution System fish screen	• Screens are cleaned after lifting each stationary vertical screen panel out of the water and pressure washing the silt and vegetation accumulation off the screens. • During the flood-up season (generally August through October), this activity can be conducted up to once a day. During the rest of the year, this activity is conducted less frequently on an as-needed basis.
26	Install new fish screen facilities	• No more than 1,000 square feet of wetlands throughout the Marsh per year shall be filled during installation of fish screens.
27	Repair or replace salinity monitoring station	•
28	Relocate, install, or remove salinity station	•
29	Placement of new riprap on exterior levees	• No more than 67 linear feet of new riprap will be placed annually. • Riprap is placed on the levee using a long-reach excavator or a clamshell or dragline dredge. • Placement of riprap will be done June through September. • Riprap will not be placed on emergent vegetation. • Placement of riprap will commence and be completed within a six-hour period, from three hours prior to low tide to three hours following low tide.

Table 4. Proposed annual dredging volume limit of 100,000 cubic yards distributed per habitat classification and Region. [Source: Reclamation (2012)]

Feature	Region 1 Volume (cy)	Region 2 Volume(cy)	Region 3 Volume(cy)	Region 4 Volume (cy)	Montezuma Slough Volume (cy)	Total Volume (cy)
Bays	0	0	100	4,000	0	4,100
Major sloughs	2,100	10,700	0	0	16,000	28,800
Minor sloughs	21,600	8,900	3,000	2,400	0	35,900
Dredger cuts	6,300	2,700	4,500	10,500	7,200	31,200
Total	30,000	22,300	7,600	16,900	23,200	100,000

Table 5. Tidal Wetland Restoration Land Acquisition Considerations. [Source: Reclamation (2012)]

Site Characteristic	Considerations
Species and Habitats	• Historical geographic ranges and current populations of species. • Abundance of nonnative invasive species. • Ability to support multiple habitat types following restoration. • Inclusion in any recovery plans. • Presence of listed species. • Connectivity to adjacent existing tidal wetlands. • Absence of existing or proposed industrial facilities in vicinity. • Presence of upland transition.
Waterfowl	• Existing suitability for supporting waterfowl populations. • Suitability for supporting waterfowl populations when restored.
Recreation	• Potential for recreationally important wildlife distributions and habitat use in surrounding areas. • Potential for, and extent of, public access. • Potential for disturbance to private property.
Site Elevation	• Amount of imported fill material and grading required. • Degree of subsidence and the ability to reverse subsidence through natural sedimentation and vegetation colonization/expansion (peat accumulation and sediment trapping) to promote functional, self-sustaining tidal wetlands plain elevations with natural upland transitions.
Water Quality	• Potential for brackish water intrusion into the Delta. • Potential for black water (low–dissolved oxygen) conditions. • Potential for adverse or beneficial effects on Delta, Suisun, and local salinity.
Levees	• Currents, winds, adjacent properties, extant channel networks, topography, etc., in selecting the location and size of levee breaches. • The extent to which the land requires flood protection levees to protect adjacent landowners. • Potential flood liability when tidal action is restored.
Estimated Costs	• Costs of acquisition and restoration. • Interim management costs. • Long term operations and maintenance needs. • Cost of upgrading interior levees to exterior levees. • Cost of maintaining and/or rehabilitating exterior levees. • Costs of maintaining levee access for construction/maintenance.
Landscape Position	• Potential for site to accommodate sea level rise. • Adjacent land uses. • Presence of infrastructure such as transmission lines, rail lines, roads, *etc*. • Relative position in relation to other planned or implemented restoration sites.
Cultural Resource Potential	• Presence or absence of known cultural resources. • Location of potential restoration areas with respect to areas sensitive for the presence of buried and surface-manifested cultural resources.

Table 6. Total restoration acreages and percentages per region. [Source: Reclamation (2012), Table 4.]

Region	SMP target for tidal wetland restoration*	Percentage of existing managed wetlands that will be restored to tidal wetland under the SMP
Region 1	1,000–1,500	8.4%–12.6%
Region 2	920–1,380	12.6%–18.9%
Region 3	360–540	12.1%–18.1%
Region 4	1,720–2,580	6.0%–9.0%
Total	**5,000–7,000**	

SMP = Suisun Marsh Habitat Management, Preservation, and Restoration Plan.

* The targets were developed for each region based on the different habitat conditions within each region to provide the range of environmental gradients necessary to contribute to the recovery of listed species. These targets complement and are consistent with the Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California. As described in the implementation strategy in the EIS/EIR, the SMP agencies will track these targets.

Note: Adjustments to the Adaptive Management Plan (Appendix A) may result in changes to the targets in each region.

Enclosure 2

**MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT
ESSENTIAL FISH HABITAT CONSULTATION**

ACTION AGENCIES:	Bureau of Reclamation, Mid-Pacific Region, Bay-Delta Office. U.S. Army Corps of Engineers, San Francisco District
ACTION:	Suisun Marsh Long-Term Habitat Management, Preservation, and Restoration Plan
CONDUCTED BY:	National Marine Fisheries Service, Southwest Region
TRACKING NUMBER:	2012-2390
DATE ISSUED:	**July 3, 2013**

Statutory and Regulatory Information

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, establishes a national program to manage and conserve the fisheries of the United States through the development of federal Fishery Management Plans (FMPs), and federal regulation of domestic fisheries under those FMPs, within the 200-mile U.S. Exclusive Economic Zone ("EEZ"). 16 U.S.C. §1801 *et seq*. To ensure habitat considerations receive increased attention for the conservation and management of fishery resources, the amended MSA required each existing, and any new, FMP to "describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary under section 1855(b)(1)(A) of this title, minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat." 16 U.S.C. §1853(a)(7). Essential Fish Habitat (EFH) is defined in the MSA as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" 16 U.S.C. §1802(10). The components of this definition are interpreted at 50 C.F.R. §600.10 as follows: "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

Pursuant to the MSA, each federal agency is mandated to consult with NMFS (as delegated by the Secretary of Commerce) with respect to any action authorized, funded, or undertaken, or proposed to be, by such agency that may adversely affect any EFH under this Act. 16 U.S.C. §1855(b)(2). The MSA further mandates that where NMFS receives information from a Fishery Management Council or federal or state agency or determines from other sources that an action authorized, funded, or undertaken, or proposed to be, by any federal or state agency will adversely affect any EFH identified under this Act, NMFS has an obligation to recommend to such agency measures that can be taken by such agency to conserve EFH. 16 U.S.C. §1855(4)(A). The term "adverse effect" is interpreted at 50 C.F.R. §600.810(a) as any impact that reduces quality and/or quantity of EFH and may include direct or indirect physical, chemical, or biological alterations 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 quantity and/or quality of EFH. In addition, adverse effects to EFH may result from actions occurring within EFH or outside EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

If NMFS determines that an action will adversely affect EFH and subsequently recommends measures to conserve such habitat, the MSA proscribes that the Federal action agency that receives the conservation recommendation must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. If the response is inconsistent with the EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (16 U.S.C. §1855(b)(4)(B)).

Background and Consultation History

The development of the Suisun Marsh Habitat Management, Preservation and Restoration Plan (SMP) has been a collaborative, multi-agency effort. In 2001, the Suisun Marsh Charter Group and Principal Agencies were formed to develop the SMP. The Charter Group consists of all local, state, and federal agencies that have jurisdiction or interest in Suisun Marsh. The Principal Agencies, who took the lead in preparing the SMP, are the Bureau of Reclamation (Reclamation), U.S. Fish and Wildlife Service (USFWS), NMFS, California Department of Fish and Wildlife (CDFW), California Department of Water Resources (DWR), and Suisun Resource Conservation District (SRCD). Reclamation is the lead federal agency for the Endangered Species Act and EFH consultation. Reclamation and USFWS are joint federal leads, and NMFS is a cooperating agency, for National Environmental Protection Act (NEPA) compliance. The U.S. Army Corps of Engineers (Corps) is also part of the Charter Group and will issue a Regional General Permit (RGP) or Letter of Permission (LOP) for managed wetland activities pursuant to Section 404 of the Clean Water Act.

As a Principal Agency for SMP, NMFS participated in the development of the SMP through public meetings, numerous interagency Charter Group and Principal Agency meetings, and review of draft NEPA documents between 2001 and 2011. Reclamation initiated EFH consultation and provided the final SMP Biological Assessment via electronic mail on June 7, 2012.

Proposed Action

The SMP addresses user conflicts in Suisun Marsh, with a multi-stakeholder approach to the restoration of tidal wetlands and the management of managed wetlands. The SMP includes a project-level description of managed wetland operations and maintenance activities to be permitted by the Corps under a Regional General Permit or Letter of Permission and a program-level of tidal restoration activities. Specifically, the SMP includes the following elements:

1. Tidal restoration

The SMP will restore 5,000 to 7,000 acres of tidal wetlands over the 30-year planning period. This tidal restoration is intended to both compensate for the effects of implementing the SMP and to contribute to recovery of species listed under the Endangered Species Act. Selection of suitable tidal restoration sites will take into consideration land available for purchase, physical and biological site characteristics, and contribution to restoration acreage goals. Once sites have been selected and acquired from willing sellers, sites will be prepared (*e.g.*, graded for re-creation of flows, excavation of starter channels, etc.), new exterior levees will be upgraded or constructed as needed to protect inboard lands from flooding, and breach locations will be selected and constructed. When sufficient detail exists about the nature, scope, location, and timing of specific restoration actions, Reclamation will provide plans to NMFS and USFWS for review. If the site-specific projects include elements or potential effects beyond those analyzed in this EFH consultation, additional site-specific consultation will be completed with NMFS.

2. Ongoing operations of managed wetlands

Managed wetlands operations include diversion and subsequent draining of tidal waters into and out of managed wetlands. CDFW and private landowners use various structures such as levees, ditches, water control facilities, grading, pumps, and fish screens to manipulate the timing, duration, and depth of flooding to meet wetland management objectives. Most wetland managers in Suisun Marsh flood their wetlands to an average depth of 8 to 12 inches in late September and October in preparation for the fall waterfowl migration. The SRCD estimates the total flooded wetland acreage is about 40,000 acres with average depth of about 1 foot, for a total diversion of 40,000 acre-feet. In mid-October to late January, water is circulated through wetlands by diverting through adjacent sloughs on flood tides and draining at ebb tides. Following waterfowl season, managed wetlands are drained in February as spring flood-up begins. Following spring flood-up wetlands are rapidly drained and flooded to half the fall water level to remove surface salts from the wetland soils (one to two leach cycles). Water remaining in the wetlands in June and July is drained to allow vegetative growth and routine maintenance activities during the summer work season. All water diversions for wetland operations will follow restrictions described in Chapter 12 of the SMP Biological Assessment.

Low dissolved oxygen (DO) and warm water conditions may result when discharges of long-impounded water from managed wetlands temporarily overwhelms receiving water in the tidal sloughs. This can occur throughout the Marsh but has been associated most with small dead-end sloughs. To minimize water quality degradation, the following best management practices will be implemented (also see best management practices below for *Install or replace exterior water control structure*):

- Pursue management options, including vegetation management and diversion timing and location, to avoid and minimize occurrence of low-DO water conditions in managed wetlands.

- Eliminate discharges to dead-end sloughs with minimal tidal exchange (Boynton and Peytonia Sloughs)
- Discourage growth of and mow broad-leaved vegetation prior to flood-up to reduce biochemical oxygen demand while ponds are inundated.
- Increase circulation in managed wetlands to reduce biochemical oxygen demand and total organic levels in drainage water.
- Implement rapid flooding and drainage to increase water aeration and encourage aerobic decomposition of vegetative matter.

3. Managed Wetland Maintenance Activities

Since 1977, CDFW and SRCD have jointly held a Regional General Permit (RGP 3) issued by the Corps, which authorizes maintenance activities within the Suisun Marsh. These activities will continue under a proposed new RGP or Letter of Permission. Maintenance activities occur on both external and internal levees or within managed ponds or adjacent tidal waters. Activities are described in Table 5a. of the SMP Biological Assessment. A subset of activities with potential adverse effects to EFH is summarized below.

a. *Replace riprap on exterior levees*

Placement of riprap on the tidal side of exterior levees in areas of erosion is currently authorized by RGP 3 to prevent continued deterioration. Under the SMP, replacement riprap will be placed in areas with existing riprap, and up to 2,000 linear feet of new riprap could be placed on external levees over the 30-year plan period. Riprap is placed using a long-reach excavator that is located on the levee crown, or by barge with a dragline or clamshell dredge. The barge method is used less frequently because it requires a greater channel width and is more expensive. Placement of exterior levee riprap is generally done during July through September dry periods. On average, approximately five sites a year with existing rip rap received riprap replacement over the last 4 years. New or replacement riprap placement on external levees will incorporate the following best management practices:

- Up to approximately 443,000 cy of replacement rip rap will be replaced in areas with existing riprap annually.
- Up to approximately 67 linear feet of new riprap will be placed annually (2,000 linear feet over 30 years of implementation).
- New exterior levee riprap will be placed only when it has been determined that the specific conditions of each site will not support other types of erosion control.
- Where new riprap is placed, integrative vegetation also will be applied where it is biologically appropriate.
- Riprap will not be placed directly on emergent vegetation and emergent vegetation will not be uprooted or displaced during placement of riprap.
- Riprap will be applied only under the following circumstances (see Chapter 2 of SMP Biological Assessment for full description):
    - Levees are exposed to channel velocities that are too high to support vegetation.
    - Channel depth on the face of the levee slope is deeper than 3 feet below MTL and the levee slope is steeper than 3:1.

- Levee face typically is exposed to vessel wakes year-round and not located in a 5 mile per hour zone.
- Fetch length exceeds 1,000 feet in the direction of the predominant southwest to southeast winds during high water conditions or prevailing winds during all other times.

b. *Install or replace exterior water control structure*

Repairing exterior water control structures involves the replacement of components of pipes, gates, stubs, and couplers that are used to either flood or drain managed wetlands. These activities are described in detail in Chapter 2 of the SMP Biological Assessment. Best management practices are included for these activities to minimize degraded water quality and other habitat impacts during managed wetlands operations (see Chapter 12 in SMP Biological Assessment for a full description):

- No more than 1,000 square feet of wetlands throughout the Suisun Marsh per year will be filled during installation of fish screens.
- All levee repairs and pipe replacement will be restricted to the dry season and not done in the rain.
- To minimize entrainment losses of fish throughout the Marsh, water control structures will be consolidated and equipped with state-of-the-art fish screens. Intakes that present the highest risk of entrainment to salmonid smolts will be given the highest priority, including intakes located on Montezuma, Suisun, and Cordelia Sloughs.
- All in-water work will be done by hand and during low tide.
- Any new or enlarged exterior water intakes and/or control structures will be screened in accordance with CDFW's criteria unless CDFW and the Corps determine the structure will not adversely affect any listed species.
- When possible, drain pipes will be relocated on the largest possible sloughs, or sloughs with the highest levels of tidal circulation possible.
- All new and replacement drain pipes will be located on the largest possible sloughs, or sloughs with the highest levels of tidal circulation possible.

c. *Dredging for repair of external levees*

Dredging is proposed in major sloughs, minor soughs, bays and historical dredger cuts to provide source materials to build up existing external levees. Dredging may also occur around fish screens or water control structures to improve circulation. A clamshell dredge or long-reach excavator could be used to dredge from either the levee crown or from a barge within the slough channel, depending on restrictions caused by vegetation on channel banks or the width of a channel. A total of 3 million cubic yards (cy) of material will be dredged over the 30-year SMP with the following best management practices:

- Up to approximately 100,000 cy of material will be dredged annually.
- The annual allotment will be divided between properties and limited to 2.1 cy per linear foot of channel, based on the linear extent of exterior levees on each property.

- Repair of levee segments with vegetation on the levee toe will be avoided if the tidal berm is more than 50 feet wide.
- Dredging from the center channel will be done to avoid emergent vegetation, and other areas with vegetation will be avoided.
- The extent of dredging disturbance will be limited based upon slough channel habitat classification and plan region (as identified in Chapter 2 of the SMP BA).
- Dredging will be tracked by SRCD using GIS to ensure that it does not occur more than once every three years on any section of levee and will not remove material deeper than 4 feet per dredging cycle.

4. Preservation Agreement Implementation Fund

In 1987, Reclamation, DWR, CDFW, and SRCD signed the Suisun Marsh Preservation Agreement (SMPA), which contains provisions for Reclamation and DWR to mitigate the effects on Suisun Marsh channel water salinity from the State Water Project and Central Valley Project operations and other upstream diversions. The SMPA PAI fund is proposed to fund certain maintenance activities to support mitigation obligations. It is funded by DWR and Reclamation and provides a funding mechanism for landowners to perform the needed maintenance activities more frequently to meet mitigation obligations. It also allows a mechanism by which federal resources may be used for proposed tidal restoration as mitigation for wetland management actions. As described in Table 13 of the SMP Biological Assessment, the PAI fund applies only to specific work activities and incorporates different cost-share strategies depending on type of work activity.

5. Implementation

Under the SMP, both tidal restoration and managed wetland activities will proceed simultaneously. The managed wetland activities will be implemented only if at least one third of the total restoration activities are implemented in each of the 10-year increments. This will ensure that restoration efforts compensate for impacts and contribute toward recovery throughout the plan implementation.

6. Reporting

To track progress of restoration and managed wetland activities, Reclamation, SRCD, DWR, and CDFW will submit implementation status reports annually to CDFW, NMFS, USFWS, and other regulatory agencies. In general, reports will include the following information (for full description of reporting see Chapter 2 in SMP Biological Assessment):

- The location, extent and timing of land acquisition for tidal restoration.
- Status of restoration planning for acquired properties.
- Descriptions of the previous years managed wetland activities, including a description of how actual impacts compare to impacts analyzed in the SMP BA.
- Description of monitoring results.
- A summary of how implemented activities compare to SMP goals in terms of habitat types, managed wetland operations, acreage goals, and species composition.

If any report indicates that restoration or managed wetland targets are not being met nor have the potential not to be met, the SMPA agencies along with NMFS and USFWS will convene to determine how to proceed to get plan implementation on track.

In addition to the best management practices described above, a full description of all proposed conservation measures are described in Chapter 12 of the SMP Biological Assessment. All best management practices and conservation measures described here, in the attached Biological Opinion and in the consultation initiation package as parts of the proposed action are intended to reduce, avoid, or otherwise compensate for adverse effects to EFH. The NMFS regards these conservation measures as integral components of the proposed action and expects that all proposed activities will be completed consistent with those measures. We have completed our effects analysis accordingly. Any deviation from these conservation measures will be beyond the scope of this consultation and may require supplemental consultation to determine what effect the modified action is likely to have on EFH.

Action Area

For purposes of this consultation, the action area is Suisun Marsh, a part of the San Francisco Bay – Sacramento-San Joaquin River Delta estuary ecosystem, and the largest contiguous brackish water marsh remaining on the west coast of North America. The primary management area consists of tidal marshes, seasonal marshes, managed wetlands, and lowland grasslands within the Marsh. Historically, much of the wetland areas of Suisun Marsh were open to tidal influence. Currently 7,762 acres of tidal wetlands remain, and 52,112 acres of wetlands are managed through a system of levees and water control structures for the purposes of water fowl hunting and managing salinity in the Sacramento-San Joaquin River Delta. Suisun Marsh also encompasses a total of 24,558 acres of bays and major sloughs and 1,108 acres of minor sloughs.

The proposed project occurs within EFH for various federally managed fish species within the Pacific Groundfish, Pacific Salmon and Coastal Pelagic Fishery Management Plans (FMPs). In addition, the project occurs within areas designated as Habitat Areas of Particular Concern (HAPC) for various federally managed fish species within the Pacific Groundfish FMP. HAPC are described in the regulations as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated HAPC are not afforded any additional regulatory protection under MSA; however, federal projects with potential adverse impacts to HAPC will be more carefully scrutinized during the consultation process. As defined in the Pacific Groundfish FMP, the SMP project area contains the following types of HAPC: coastal estuary HAPC and submerged aquatic vegetation (*e.g.*, sago pondweed) HAPC.

Effects of the Action

Based on information provided in the EFH assessment and developed during consultation, NMFS concludes that proposed action will adversely affect EFH for various federally managed species within the Pacific Groundfish, Pacific Salmon, and Coastal Pelagic FMPs through (1) temporary turbidity increases in the water column, (2) disturbance of benthic habitats, (3) disturbance to submerged aquatic vegetation HAPC, (4) permanent conversion of soft bottom habitat to artificial hard substrate, (5) temporary degradation of water quality and (6) permanent increases in tidal wetland EFH.

(1) *Turbidity*

Short term increases in turbidity will occur during dredging, water control structure replacement/maintenance, levee breaches for tidal restoration, and managed wetland draining. While fish in San Francisco Bay and Suisun Marsh are exposed to naturally elevated concentrations of suspended sediments resulting from storm flow runoff events, wind and wave action, and benthic foraging activities of other aquatic organisms (Schoellhammer 1996), dredging and other human-induced concentrations of suspended sediments may be significantly elevated to have direct effects on fish behavior. If suspended sediment loads remain high for an extended period of time, fish may suffer increased larval mortality (Wilber and Clarke 2001), reduced feeding ability (Benfield and Minello 1996) and be prone to fish gill injury (Nightingale and Simenstad 2001).

Elevated turbidity that occurs in Suisun Bay, major sloughs or minor sloughs within Suisun Marsh is expected to dissipate within one tidal cycle due to high tidal flushing. Similarly, increased turbidity levels from levee breaches will be temporary, and benefits from long-term increases in tidal wetland habitat will compensate for the temporary habitat degradation. Furthermore, implementation of numerous best management practices and conservation measures proposed as part of the SMP should minimize episodes of elevated turbidity in space and time.

(2) *Benthic disturbance*

Dredging the maximum annual amount of 100,000 cubic yards will result in impacts to approximately 66 acres within Suisun Marsh. However, based on current needs and feasibility analysis, SRCD anticipates no more than 30,000 cubic yards of dredging per year for a footprint of 19.7 acres. This dredging will result in benthic disturbance and removal of invertebrate prey within the dredge footprint. Many EFH species forage on infaunal and bottom-dwelling organisms, such as polychaete worms, crustacean, and other EFH prey types. Dredging may adversely affect these prey species at the site by directly removing or burying these organisms (Newell *et al.* 1998, Van der Veer *et al.* 1985) and providing substrate for invasive species. Recolonization studies suggest that recovery (generally meaning the later phase of benthic community development after disturbance when species that inhabited the area prior to disturbance begin to re-establish) may not be quite as straightforward, and can be regulated by physical factors including particle size distribution, currents, and compaction/stabilization processes following disturbance. Rates of recovery listed in the literature range from several months to several years for estuarine muds (McCauley *et al.* 1976, Oliver *et al.* 1977, Currie and Parry 1996, Tuck *et al.* 1998, Watling *et al.* 2001) to up to 2 to 3 years for sands and gravels (Reish 1961, Thrush *et al.* 1995, Watling *et al.* 2001, Gilkinson *et al.* 2005). Recolonization can also take up to 1 to 3 years in areas of strong current but up to 5 to 10 years in areas of low current (Oliver *et al.* 1977). Thus, forage resources for fish that feed on the benthos may be substantially reduced before recovery is achieved. Based on available literature, NMFS will assume recovery of prey resources will not occur within one year.

As described above, SRCD will ensure dredging does not occur at the same location more than once is a three year period. This measure should allow for some level of benthic invertebrate recovery between dredging events. Furthermore, dredging will be limited by annual dredge volume limits by habitat type (*e.g.*, minor sloughs, major sloughs, bays, dredger cuts) to decrease the extent of impacts to any one habitat type within Suisun Marsh. The benthic monitoring proposed in the SMP (SMP Biological Assessment Appendix E) will provide further information regarding dredging impacts to benthic communities and their recovery, and ensure effects from dredging are not greater than what is expected.

(3) *SAV disturbance*

Sago pondweed (*Stuckenia* spp.) is present in Suisun Bay, Little Honker Bay, Suisun Slough, Montezuma Slough and potentially elsewhere in Suisun Marsh (Boyer *et al*. 2012). While little is known about the function of this submerged aquatic vegetation in Suisun Marsh, it is a native plant, likely provides refuge for fish from predators, and contributes to primary and secondary productivity. It may also help to stabilize sediments along the shoreline and base of levees. NMFS Habitat Conservation Division has contributed funds to San Francisco State University for studies to learn more about the distribution and function of sago pondweed beds as fish habitat.

Dredging for levee maintenance could disturb or remove sago pondweed, decreasing the quantity of an EFH HAPC. The location and amount of disturbance will depend on specific location of dredging in any given year relative to sago pondweed presence, and the ability of sago pondweed to re-vegetate an area after disturbance.

(4) *Conversion of Habitat*

Placement of new riprap for levee repair will convert intertidal soft bottom habitat to artificial hard substrate. With this conversion, soft bottom areas, that are habitat for infaunal and bottom-dwelling organisms, such as polychaete worms, crustaceans and other EFH prey types, are lost, resulting in a decrease in EFH foraging areas. Best management practices and conservation measures proposed in the SMP will limit placement of riprap to areas of high erosion and loss of vegetation, which likely already have reduced function as fish foraging and rearing areas. Furthermore, placement of new riprap will be limited to 2,000 linear feet over the 30-year SMP period, with no more than 200 feet annually over 200 miles of levees within Suisun Marsh. As such, conversion of soft bottom habitat will only occur in a limited area.

(5) *Water Quality*

Managed wetland operations can result in degraded water quality in tidal areas when water with high temperatures and low dissolved oxygen, and high sulfides, are discharged from managed ponds. On average salinity and temperature levels in drain water are similar or slightly higher than ambient conditions in adjacent tidal waters. In the most large and medium sloughs, diurnal tide cycles provide adequate circulation to dissipate discharge water quickly and avoid large fluctuations in water quality. However, areas with small dead-end sloughs with little tidal exchange can experience low dissolved oxygen with managed wetland discharge in May, June and October. Fish exposed to low dissolved oxygen conditions can experience reduced metabolic rates, growth, swimming performance, and survival.

Modifications to wetlands operations through RGP 3 have been effective in reducing or eliminating poor water quality events. The SMP includes a number of ongoing and new management measures to further avoid and reduce episodes of low dissolved oxygen and high temperatures. With implementation of these measures, degraded water quality conditions from managed wetlands discharge should be isolated in time and space within Suisun Marsh. Furthermore, tidal restoration implemented as part of the plan will increase tidal circulation in newly restored and adjacent areas and decrease the discharge of poor water quality water into sloughs.

(6) *Increased quantity of tidal wetlands*

The proposed tidal restoration will increase connectivity and tidal exchange among marsh, intertidal and subtidal sloughs, and bays in Suisun Marsh. Benefits of restored tidal wetlands include increased quantity of wetland habitat accessible to managed fish, increases in food production through primary and secondary production in restored wetlands and adjacent waters, and improved water quality through reduction of managed marsh discharges. The specific timing and location of tidal restoration is unknown at this time. However, the SMP calls for a total of 5,000 to 7,000 acres of tidal restoration with equal acreages restored within each of the three 10-year implementation periods in order to sufficiently compensate for managed wetland operations and maintenance activities.

EFH Conclusions

As described in the above effects analysis, NMFS has determined that the proposed Suisun Marsh Habitat Management, preservation and Restoration Plan will adversely affect EFH for various federally managed fish species within the Pacific Groundfish, Pacific Salmonid, and Coastal Pelagic FMPs through temporary increases in turbidity, small areas of soft bottom habitat conversion, degraded water quality events, and disturbance to soft bottom and sago pondweed habitat. The project incorporates numerous conservation and mitigation measures to address adverse effects of turbidity, water quality, habitat conversion, and soft bottom habitat conversion. The EFH Conservation Recommendations below are provided to address impacts to sago pondweed habitat.

Conservation Recommendations

1. To minimize adverse effects to submerged aquatic vegetation EFH-HAPC, to the extent feasible, dredging should not occur in areas with native sago pondweed (*Stuckenia* spp).

2. If impacts to sago pondweed during dredging episodes are unavoidable, Reclamation and SRCD should ensure that pre- and post-dredging surveys of native sago pondweed are completed within the proposed dredge area and a suitable control site. Pre-dredge surveys should be completed within 30 days prior to dredging. Post-dredge surveys should be completed within 60 days of dredging. In addition, post-dredge monitoring

should occur at the dredge and control sites for two years following the dredge episode (*i.e.*, post-dredge survey plus two years of monitoring). All survey and monitoring results should be provided to NMFS Santa Rosa Office within 30 days of completion. If after three years of SMP implementation, monitoring reports demonstrate that sago pondweed does not recover within dredge project areas, NMFS may recommend the SMP dredging program be modified to incorporate sago pondweed mitigation to compensate for adverse effects from dredging.

Please be advised that regulations 50 CFR 600.920k to implement the EFH provisions of the MSA require your office to provide a written response to this programmatic consultation within 30 days of its receipt and prior to its use. A preliminary response indicating the anticipated submission date of the final response is acceptable if a final response cannot be completed within 30 days. Your final response must include a description of how the EFH Conservation Recommendations will be implemented and any other measures that will be required to avoid, mitigate, or offset the adverse impacts of the activity. If your response is inconsistent with any of our EFH Conservation Recommendations, you must provide an explanation for not implementing the recommendations at least 10 days prior to final approval of the action. This explanation must include scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects.

Supplemental Consultation

Pursuant to 50 CFR 600.920(l), the USCG 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.

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