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-2017-8340

September 25, 2018

Alessandro Amaglio
Environmental Officer
Federal Emergency Management Agency
U.S. Department of Homeland Security
Region IX
1111 Broadway, Suite 1200
Oakland, California 94607-4052

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 Disaster, Mitigation, and Preparedness Programs in California

Dear Mr. Amaglio:

Thank you for your letter of November 15, 2017, 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 Federal Emergency Management Agency's Disaster, Mitigation and Preparedness Programs in California. This letter transmits NMFS' biological opinion (BO) based on information provided in the biological assessment provided on November 15, 2017, and email discussions between NMFS and Federal Emergency Management Agency clarifying project description and effects of the project. A complete administrative record of this consultation is on file at the NMFS California Central Valley Office.

Based on the best available scientific and commercial information, the BO concludes that the Federal Emergency Management Agency's Disaster, Mitigation and Preparedness Programs (Programmatic) is not likely to jeopardize the continued existence and is not likely to destroy or adversely modify the designated critical habitat of 13 federally listed:

North American green sturgeon (*Acipenser medirostris*) Southern DPS,
California coastal Chinook (*O. tshawytscha*),
Central Valley Spring-run Chinook (*O. tshawytscha*),
Sacramento River Winter-run Chinook (*O. tshawytscha*),
Southern Oregon/Northern California Coast Coho (*O. kisutch*),
Central California Coast Coho (*O. tshawytscha*),
Southern California Steelhead (*O. mykis*s),
South-Central California Coast Steelhead (*O. mykiss*),

Northern California Steelhead (*O. mykiss*),
Central Valley Steelhead (*O. mykiss*),
Central California Coast Steelhead (*O. mykiss*),
Southern DPS Eulachon (*Thaleichthys pacificus*), or
Black abalone (*Haliotis cracherodii*).

NMFS has included an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the program.

This letter also transmits NMFS's review of the likely effects of the proposed action on essential fish habitat (EFH) for Pacific Coast Salmon, Coastal Pelagic Species, Pacific Coast Groundfish, and Highly Migratory Species, designated under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), including conservation recommendations. This review was pursuant to section 305(b) of the MSA, implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation. We concluded that the project would adversely affect the EFH of Pacific Coast Salmon, Coastal Pelagic Species, and Pacific Coast Groundfish in the action area and have included recommendations.

Please contact Abbie Moyer in NMFS' California Central Valley Office at (916) 930-3707 or via email at Abbie.Moyer@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Maria Rea
for Barry A. Thom
Regional Administrator

Cc: To the file: 151422-WCR2017-SA00388
Lorena Solorzano-Vincent, lorena.solorzano-vincent@aecom.com
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Endangered Species Act (ESA) Section 7(a)(2) Programmatic Biological Opinion, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, and Fish and Wildlife Coordination Act Recommendations for the

Federal Emergency Management Agency's Disaster, Mitigation, and Preparedness Program in California

National Marine Fisheries Service (NMFS) Consultation Number: *WCR-2017-8340*

Action Agency: Federal Emergency Management Agency, Region IX Oakland, California

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?
North American green sturgeon (*Acipenser medirostris*) Southern DPS	Threatened	Yes	No	Yes	No
California Coastal Chinook (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
Central Valley Spring-run Chinook (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
Sacramento River Winter-run Chinook (*O. tshawytscha*)	Endangered	Yes	No	Yes	No
Southern Oregon/Northern California Coast Coho (*O. kisutch*)	Threatened	Yes	No	Yes	No
Central California Coast Coho (*O. tshawytscha*)	Endangered	Yes	No	Yes	No
Southern California Steelhead (*O. mykis*s)	Endangered	Yes	No	Yes	No
South-Central California Coast Steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Northern California Steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
California Central Valley Steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Central California Coast Steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Southern DPS Eulachon (*Thaleichthys pacificus*)	Threatened	Yes	No	Yes	No
Black abalone (*Haliotis cracherodii*)	Endangered	Yes	No	Yes	No

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes
Coastal Pelagic Species	Yes	Yes
Pacific Coast Groundfish	Yes	Yes
Highly Migratory Species	Yes	Yes

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

Issued By:

Maria C Rea

for Barry A. Thom
Regional Administrator

Date: **September 25, 2018**

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List of Acronyms

AMM	Avoidance Minimization Measures
BA	biological assessment
BCSSRP	Battle Creek Salmon and Steelhead Restoration Program
BO	Biological Opinion
BRT	Biological Review Team
°C	Degrees Celsius
Cal OES	California Office of Emergency Services
CCV	California Central Valley
CDFG	California Department of Fish and Game
CDFW	California Department of Fish Wildlife
CRF	Code of Federal Regulations
cfs	Cubic Feet per Second
CNFH	Coleman National Fish Hatchery
CV	Central Valley
CVP	Central Valley Project
CVFPB	Central Valley Flood Protection Board
CWA	Clean Water Act
dB	Decibels
DDT	Dichlorodiphenyltrichlor
Delta	Sacramento-San Joaquin Delta
DO	Dissolved Oxygen
DPS	distinct population segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
°F	Degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FI	Functionally Independent
FMP	Fisheries Management Plan
FRFH	Feather River Fish Hatchery
ha	Hectare
HAPC	Habitat Area of Particular Concern
HU	Hydrologic Unit
ITS	Incidental Take Statement
IWM	Instream Woody Material
km	Kilometer
LSNFH	Livingston Stone National Fish Hatchery
LWD	Large Woody Debris
LWM	Large Woody Material
m	Meter
MHHW	Mean Higher High Water
MLLW	Mean Lower Low Water
MOU	Memorandum of Understanding
MSA	Magnuson-Stevens Fishery Conservation and Management Act

nDPS	Northern Distinct Population Segment
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PBA	Programmatic Biological Assessment
PBO	Programmatic Biological Opinion
PBF	Physical Biological Feature
PCE	Primary Constituent Elements
PFMC	Pacific Fisheries Management Counsel
PI	Potentially Independent
RBDD	Red Bluff Diversion Dam
RHA	Rivers and Harbors Act
RM	River Mile
RPA	Reasonable and Prudent Alternative
RRCSCBP	Russian River Coho Salmon Captive Broodstock Program
SDFPF	Skinner Delta Fish Protection Facility
sDPS	Southern Distinct Population Segment
SRA	Shaded Riverine Aquatic
SWP	State Water Project
TCD	Temperature Control Device
TFCF	Tracy Fish Collection Facility
TRT	Technical Review Team
USACE	United State Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
VSP	Viable Salmonid Populations
WS-RLO	Rickettsiales-like Organism
YOY	Young of Year

Note: Throughout this document there are references cited as CDFG. This refers to the California Department of Fish and Game. This name was changed to California Department of Fish and Wildlife on January 1, 2013. However, for consistency on publications, references prior to January 1, 2013, will remain CDFG.

Tables

Figures

1. INTRODUCTION

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

1.1 Background

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

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

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). 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 California Central Valley Office.

1.2 Consultation History

This programmatic BO is the culmination of several years of collaboration with FEMA and NMFS. In 2011, FEMA developed a programmatic approach for ESA compliance with NMFS, which lead to the preparation of a programmatic biological assessment (PBA). The key elements of these coordination efforts between FEMA and NMFS, which have led to the preparation of this BO, include:

September 2011, FEMA sent a fact sheet on the PBA Framework to NMFS;

January 2012, FEMA and NMFS held a meeting to discuss the PBA;

From 2012 through 2014, FEMA sent various interim draft sections of the PBA and other draft documents to NMFS;

From 2014 through 2016, FEMA and NMFS participated in recurring calls for coordination;

October 22, 2015, FEMA submitted the Draft FEMA PBA for NMFS to review;

January 2016, NMFS sent FEMA comments on the Draft FEMA PBA;

Throughout 2016, NMFS and FEMA participated in regular calls and exchange of interim draft documents for this programmatic consultation;

March 2017 through October 2017, FEMA submitted additional draft sections of the FEMA PBA document, and NMFS and FEMA participated in weekly coordination calls;

November 15, 2017, FEMA submitted the Final FEMA PBA to NMFS;

December 19, 2017, NMFS submitted questions to FEMA regarding the Final PBA, following NMFS's sufficiency review;

December 21, 2017, FEMA responded to NMFS's questions;

December 21, 2017, NMFS initiated formal consultation.

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 proposed action is designed to provide a programmatic consultation to cover typical recurring disaster reponse, recovery, mitigation, and preparedness program actions funded by FEMA in California. The intent of undergoing this programmatic consultation is to cover many of the typical reoccurring actions funded by FEMA in California that effect listed species and designated critical habitat under the jurisdiction of NMFS. This would allow FEMA to more effectively prepare for and respond to disasters, enabling FEMA to expedite recovery from a disaster while meeting the requirements of the ESA, and reducing impacts of disaster, mitigation and preparedness actions on the environment.

The proposed action for this consultation is a "mixed programmatic action," as defined by 50 CFR § 402.02, because it approves some actions that are not subject to further section 7 consultation (referred to as Standard Actions), as well as a framework for the development of future actions that would be authorized at a later time (referred to as Framework Actions). For the actions authorized at a later time, take of listed species would not occur until that subsequent authorization. For the non-framework actions, including construction activities, this biological opinion (BO) will serve as the final ESA consultation and, as required by section 7 of the ESA, with respect to those actions NMFS is providing an incidental take statement with this BO. For the Framework Actions a programmatic level of analysis is completed but lack sufficient detail to analyze to the level of take; therefore, those activities are not expected to occur until further authorization and section 7 analysis is completed (see Section 1.3.3 Description of Framework Actions).

Under 50 CFR § 402.02, "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). Interrelated and interdependent actions that are reasonably certain to occur as part of a preparedness, response, recovery, or mitigation activity include the continued operation and maintenance of structures and facilities included in the proposed action.

1.3.1 Overview of Proposed Action

FEMA administers federal grant programs to assist with preparedness, response, recovery, and mitigation for natural and human-caused disasters. These disasters can result from natural events, such as floods, earthquakes, wildfires, rains, and windstorms; and human-caused events, such as fires and terrorist attacks. When administering these federal grant programs, FEMA must comply with applicable Federal statutes, including the ESA and MSA. FEMA has determined that the majority of typical recurring actions proposed for funding, and for which a BO is required, can be consulted on in a programmatic manner, as described in this BO.

Over a five year period, this BO is designed to cover many of the typical recurring actions funded through these grant programs in California. For a proposed action to be covered under this BO, the project must meet the suitability criteria for ESA compliance and the suitability criteria for MSA compliance outlined below in Section 1.3.7 and 1.3.8, must follow the applicable Avoidance and Minimization Measures (AMM) outlined below in Section 1.3.9, and must be agreed upon by FEMA and NMFS. If a proposed project does not meet the criteria outlined below, an individual ESA consultation would be required. As the federal action agency, FEMA is ultimately responsible for determining if a project is covered under this BO, and for implementing the applicable AMMs and conservation measures.

This proposed action requires avoidance and minimization measures specific to an activity type to reduce and avoid effects of the action on federally listed species, designated and proposed critical habitat, and EFH. These include adherence to construction work windows, erosion and sedimentation prevention measures, spill prevention measures, biological monitoring, environmental awareness training for construction personnel, integration of NMFS guidance on fish passage design and fish screening criteria, and implementing bioengineering techniques.

The projects funded through FEMA's Disaster, Mitigation and Preparedness Programs in California that are included as part of the proposed action but would be authorized at a later time (Framework Actions) include the following:

- Constructing, Modifying, or Relocating Facilities
    - Upgrading or Modifying Facilities
    - Providing Temporary Facilities
    - Acquiring and Demolishing Existing Facilities
    - Constructing New Facilities or Relocating Existing Facilites
    - Developing Demonstration Projects
- Actions Involving Watercourses and Coastal Features
    - Constructing a Water Detention, Retention, Storage, or Conveyance Facility
    - Constructing Other Flood Control Structures.

These actions are fully described in Section 1.3.3. Table 1 provides a complete summary of the project types that are considered Framework Actions in this BO.

The projects funded through FEMA's Disaster, Mitigation and Preparedness Programs in California that are included as part of the proposed action and are not subject to future section 7 consultation (Standard Actions) include the following:

- Non-Emergency Debris Removal
- Constructing, Modifying, or Relocating Facilities
    - Repairing, Realigning, or Otherwise Modifying Roads, Trails, Utilities, and Rail Lines
    - Relocating the Function of an Existing Facility
- Actions Involving Watercourses and Coastal Features
    - Repairing, Stabilizing, or Armoring Embankments
    - Constructing a Water Crossing
    - Constructing an Existing Coastal Feature
- Wildfire Risk Reduction
    - Mechanical or Hand Clearing of Vegetation
    - Biological Control.

These actions are fully described in Section 1.3.4. Table 1 provides a complete summary of all the project types that are considered Standard Actions in this BO.

FEMA shall prepare an annual report (for each of the 5 years covered by this BO) to NMFS containing a summary of the numbers and types of projects completed under this programmatic. This annual report would include a tabular summary of the projects implemented that were covered under this programmatic each year. An accounting of take based on a number of individuals or disturbance to suitable habitat as a surrogate would be provided in the annual report, which would also include a tally of the total from all prior years.

1.3.2 Disaster, Mitigation, and Preparedness Programs

This BO covers projects that FEMA administers for disaster preparedness, response, recovery, and mitigation in California. Under these programs, FEMA provides Federal financial assistance to projects completed by State and territorial governments; Federally-recognized tribes; local governments, including cities, counties, special districts, and other local and regional entities; certain private non-profit organizations; and individuals and households. Generally, these programs fall into two categories: disaster and non-disaster programs. Both Standard and Framework Actions may be administered by these programs.

1.3.2.1 Disaster Programs:

FEMA is authorized to provide disaster assistance by the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. §§ 5121–5207), as amended ("Stafford Act"). Pursuant to the Stafford Act, the President may declare an emergency or major disaster when an event exceeds the capabilities of State, local, and tribal governments to respond and recover. This declaration enables FEMA to make supplemental assistance available, either directly through Department of Defense and other Federal agencies, or through financial assistance programs. Financial assistance programs are generally funded through Congressional appropriations in the Disaster Relief Fund, which Congress replenishes periodically. Pursuant to the Stafford Act, FEMA provides funds through the following:

- Programs to help individuals and households who have been affected by the disaster, including assistance with minor home repairs, temporary housing, transportation, medical assistance, funeral assistance, crisis counseling, and disaster legal services; extraordinary costs of State, territorial, tribal, and local governments for measures to save lives, protect public health and safety, and protect improved property;

- Repair or replacement of disaster-damaged buildings and infrastructure owned by State, territorial, tribal, and local governments, and by certain private non-profit entities (such as hospitals, schools, and electrical cooperatives);

- Alternate projects, in situations where a public or private non-profit facility owner determines that it is not in the public's interest to restore a disaster-damaged facility;

- As part of the repair of a disaster-damaged facility, implementation of cost-effective measures to reduce the risk of damage to that facility in future, similar disasters;

- State-, territory-, and tribally-managed hazard mitigation programs to reduce the risks associated with future disasters through community-wide and facility-specific mitigation measures; and

- Assistance to States, territories, and tribes for extraordinary costs associated with fighting wildfires, including measures to reduce post-fire erosion, flooding, and debris flows.

For some of these activities, the costs are shared between FEMA and the State.

1.3.2.2 Non-Disaster Programs

FEMA also implements a wide range of non-disaster financial assistance programs under the authority of several laws. In general, Congress provides funding for these programs through annual appropriation, and the Federal share of program costs varies. These programs include the following:

- State-, territory-, and tribally-managed hazard mitigation programs.

- Planning, project, and technical assistance to States, territories, tribes, and local governments to reduce the risk of flood damage to public and privately owned buildings, thereby reducing the financial impact of flooding.

- Programs to enhance the preparedness of States, territories, tribes, local governments, and urban areas through financial assistance for planning, training, exercises, and the purchase of systems and equipment. These programs include funding for State emergency management agencies, regional organizations, law enforcement and firefighting agencies, medical services providers, transportation providers, operators of critical infrastructure, and organizations devoted to the preparedness of the general public.

1.3.3 Description of Framework Actions

1.3.3.1 Constructing, Modifying, or Relocating Facilities

As a Framework Action, FEMA may provide funds for constructing, modifying, or relocating facilities. Relevant actions include (Table 1):

- Upgrading or otherwise modifying structures;
- Providing temporary facilities;
- Acquiring and demolishing existing facilities;
- Constructing new facilities or relocating existing facilities; and
- Developing demonstration projects.

During construction, avoidance and minimization measures would be used and incorporated as part of the action (see Section 1.3.9 Avoidance and Minimization Measures).

1.3.3.1.1 Upgrading or Otherwise Modifying Facilities

As a Framework Action, FEMA may provide funds to implement changes required by current building codes and standards, or otherwise modify existing structures (Table 1). Often, these changes make the structure more resistant to damage in future events. Typical activities would include:

- Making structures more fire-resistant (e.g., by replacing roofs and doors with fire-resistant materials);
- Installing bracing, shear panels, shear walls, anchors, or other features so that structures are better able to withstand seismic events or high wind or snow loads;
- Modifying structures to reduce the risk of damage during floods by elevating structures above the expected flood level or by floodproofing; and
- Modifying structures to meet another need of a subapplicant, such as through an improved project or an alternate project.

A structure can also be floodproofed so that floodwaters can encounter it without causing damage to the structure or its contents. Dry floodproofing methods involve the installation of flood shields, watertight doors and windows, earthen barriers, and pumping systems to prevent water from entering the structure. Wet floodproofing involves the installation of vents and flood-resistant materials so that water may enter and leave areas of the structure without causing damage. With both dry and wet floodproofing, utilities must be modified, elevated, or relocated to prevent floodwaters from accumulating within them.

1.3.3.1.2 Providing Temporary Facilities

As a Framework Action, FEMA may provide temporary housing facilities when a disaster renders homes uninhabitable for long periods (Table 1). Such facilities typically consist of manufactured housing. Typical activities may involve:

- Developing the pads for dwellings;
- Constructing ancillary facilities, such as roads, streets, and parking lots;
- Installing utilities, such as potable water lines, sewer hookups, electricity (including street lighting), and telephones lines; and
- Installing manufactured homes.

Additionally, FEMA may modify existing facilities to serve as temporary housing. Appropriate sites would not be located in a floodplain and would not contain wetlands or critical habitat, affect historic properties or archaeological sites, or contain hazardous materials. Installation of housing units and utilities would be accomplished in accordance with current codes and standards. After temporary housing is no longer needed at the disaster site, FEMA would remove the temporary housing units and associated ancillary facilities, and restore the land to its original use. All removed materials would be stored for future use or disposed of in accordance with applicable laws and regulations.

Another method that FEMA would use to provide temporary housing involves modifying existing facilities to serve as temporary housing. These facilities could consist of existing residential property or the adaptive reuse of non-residential facilities. Specific activities would range from conducting repairs and minor upgrades to complete reconstruction of a building's interior. This action may involve acquisition or leasing of facilities. Modifying existing facilities for temporary housing may be conducted by FEMA directly or by providing funding to a recipient (subapplicant).

FEMA may also provide funding for temporary relocation of essential public services, in the event that the structures that house these services are damaged, destroyed, or otherwise rendered inaccessible by a disaster. Funds may also be provided for upgrades necessary to meet current codes and standards, and for the installation or modification of appurtenances, such as utilities, that are necessary to operate facilities.

1.3.3.1.3 Acquiring and Demolishing Existing Facilities

As a Framework Action, FEMA may provide funds for the acquisition and demolition of existing facilities, particularly if they are located in high-hazard areas and are subject to repetitive loss (Table 1). Typically, these facilities are at a high risk because of: (1) damage from flooding; (2) erosion of stream banks, beaches, slopes, or bluffs; (3) landslides; or (4) wildfire. These facilities may consist of private properties, such as houses and commercial buildings, or publicly owned facilities, such as utilities, roads, and bridges. A local government entity would purchase private properties on a willing-seller basis and, after the property is purchased, the property would be dedicated and maintained in perpetuity for uses compatible with open space, recreation, or wetlands management practices, pursuant to 44 CFR Part 206.434(e).

Existing facilities would be either removed or demolished. All demolition materials would be disposed of at approved and licensed disposal sites, in compliance with applicable laws and regulations. Any hazardous materials or other contaminants would be removed and disposed of in an appropriate manner. Construction debris and household materials may be recycled if recycling facilities exist. Once structures are removed, lots would be graded to conform to the local topography, and disturbed areas would be revegetated with species approved for the local area. Frequently, the local government would develop the acquired land for recreational or open space uses, such as parks, athletic fields, or walking and biking trails.

1.3.3.1.4 Constructing New Facilities or Relocating Existing Facilities

If a facility is located in a floodplain or other hazardous area,[1] is subject to repetitive damage, or has been damaged in such a way that restoration in the current location is not practical or cost-effective, as a Framework Action, FEMA may fund the construction of a new facility or the physical relocation of the existing facility (Table 1). Examples of this action include construction of roads, trails, utilities and utility lines, and rail lines in a different area from the existing facility; construction and relocation of buildings; and construction of drainage improvements.

In both new facility construction and physical relocation, FEMA may fund the cost of land acquisition and the construction of appurtenant features, such as access roads and utilities. For properties in the hazard area, FEMA would acquire damaged properties, demolish existing structures (except in cases of physical relocation), and places deed restrictions that would limit future uses to open space in perpetuity. However, FEMA does not acquire land directly nor does it become a land owning agency as a result of this process.

1.3.3.1.5 Developing Demonstration Projects

Demonstration projects focus on public education and are designed to highlight procedures that the public can use to reduce property damage during flood, earthquake, wildfire, wind, and rainstorm disasters and may qualify as Framework Actions. Demonstration projects may involve the development of a model facility to demonstrate how hazard mitigation technologies can be used to reduce potential damage during a disaster. Flood demonstration projects may involve items such as elevating a structure or waterproofing windows and doors that are below the base flood elevation. A fire demonstration project may include vegetation management around a facility and replacing roofs, doors, and windows with fire-resistant materials. Wind and

[1] Hazard areas are susceptible to some type of natural hazard, such as flooding, seismic activity, coastal inundation, or mudslide.

earthquake demonstration projects may include changes to the structural design of buildings to allow them to withstand higher wind velocity or more movement during an earthquake.

1.3.3.2 Actions Involving Watercourses and Coastal Features

Framework Actions include some projects involving watercourses and coastal features (Table 1).

Relevant categories of activities include the following:

- Constructing or modifying a water detention, retention, storage, or conveyance facility; and
- Constructing, repairing, or modifying coastal and other flood control structures

During construction, avoidance and minimization measures would be used and incorporated as part of the action (see Section 1.3.9 Avoidance and Minimization Measures).

1.3.3.2.1 Constructing a Water Detention, Retention, Storage, or Conveyance Facility

Constructing a water detention, retention, storage, or conveyance facility may include the construction, enlargement, or restoration of detention basins, retention basins, sediment ponds, reservoirs, or conveyance facilities, such as irrigation ditches or flumes, to reduce flood flows or to provide a water source for fighting fires in an area of high fire hazard. The creation and/or enlargement of water storage reservoirs would be most frequently associated with flood disasters and to a lesser extent, fire disasters.

Detention basins, retention basins, sediment ponds, and reservoirs would be constructed to temporarily store floodwater to reduce downstream peak flows. The stored water would be released at a slower rate so that the existing drainage-ways can convey water without contributing to downstream flooding. All areas that would be disturbed during the construction of these features would be revegetated with native plant species. This action would also include the repair or restoration of water retention or conveyance structures. All sediment removed from these features would be disposed of in a manner consistent with Federal, State, and local laws and regulations.

Frequently in rural areas, firefighting is heavily constrained by the lack of water that firefighters can use. In response to this need, proposed activities may also include the creation of retention facilities in locations that firefighters can readily access, either as a direct source of water or as a source of water to fill water supply trucks. All areas that would be disturbed during the construction of a retention facility would be revegetated with native plant species.

1.3.3.2.2 Constructing Coastal and other Flood-Control Structures

Coastal structures protect shorelines and coastal features from erosion and manage sediment transport. A flood-control structure is a facility designed to reduce the risk that floodwaters could inundate a flood-prone area. Typical examples are levees (also referred to as dikes) and floodwalls. Activities would include:

- Constructing, replacing, or modifying seawalls, groins, jetties, revetments, levees, dikes, and floodwalls

- Modifying or installing interior drainage systems to reduce the risk of damage behind levees and floodwalls during heavy rains or flooding events on streams located in protected areas.

- Modifying or installing new bank protection of a shoreline structures

- Raising the height of existing flood control structures to prevent overtopping in future floods

Levees would be repaired or constructed using bioengineering techniques, compacted fill (discussed in the Avoidance and Minimizaion Measures Section 1.3.9) and, in some cases, riprap protection. Bare earth would be seeded with grasses to prevent erosion. Typically, a gravel road would be installed on the levee's crest to allow for maintenance. Floodwalls, typically built in urban areas, would be constructed using reinforced concrete or grouted, reinforced concrete block. Excavation would be necessary to install footings. Levees and floodwalls would both have interior drainage systems that may include pumps for removing accumulated water.

1.3.4 Description of Standard Actions

1.3.4.1 Non-Emergency Debris Removal

Standard Actions include projects involving non-emergency debris removal (Table 1). Debris removal performed in non-emergency situations includes:

- Removing rock, silt, sediment, or woody debris that floodwaters have deposited in harbors and ports, stream channels, bridge and culvert openings, canals, sedimentation basins, sewage treatment ponds, ditches, and other facilities in such a manner as to disrupt normal flows, navigation, recreation, or municipal services.

Removal of material from stream channels usually requires coordination with the United States Army Corps of Engineers (USACE) for compliance and permitting under the Clean Water Act (CWA) and Rivers and Harbors Act (RHA). All removed debris would be disposed of at approved and licensed disposal sites, in compliance with existing laws and regulations. Any hazardous materials or other contaminants would be removed and disposed of in an appropriate manner. Woody debris and construction materials can be recycled if recycling facilities exist.

1.3.4.2 Constructing, Modifying, or Relocating Existing Facilities

As a Standard Action, FEMA may provide funds for constructing, modifying, or relocating existing facilities (Table 1). Relevant actions include:

- Repairing, realigning, or otherwise modifying roads, trails, utilities, and rail lines; and

- Relocating the function of an existing facility.

During construction, avoidance and minimization measures would be used and incorporated as part of the action (see Section 1.8 Avoidance and Minimization Measures).

1.3.4.2.1 Repairing, Realigning, or Otherwise Modifying Roads, Trains, Utilities, and Rail Lines

Roads, trails, utilities,[2] and rail lines are typically damaged when floods cause structural damage, or when floods or heavy rains cause erosion, subsidence, or landslides. Earthquakes may cause similar damage. Repairs would be accomplished by replacing earthen material lost during the disaster and replacing the damaged surface, utility line, or, in the case of rail lines, ballast, and track. Stabilizing the replacement fill using rock, grout, timber walls, or steel sheet piling may be necessary. Hazard mitigation measures may be performed to prevent or limit future damage. For example, a pipe may be installed to convey drainage beneath a road, thus preventing future washouts, or a utility line may be encased in concrete in an area vulnerable to erosion. Such projects may qualify as Standard Actions (Table 1).

If the area of damage is unstable, does not allow for repair, or is subject to repetitive loss, a facility may be realigned so that the area of damage is avoided. Property acquisition or a change in easement may be necessary.

Facilities may also be modified as part of improved projects or alternate projects under the Public Assistance Program to meet additional needs of the proposed action.

1.3.4.2.2 Relocating the Function of an Existing Facility

As a Standard Action, FEMA may fund the relocation of a function of a facility to an existing facility that has adequate capacity to handle the additional load with minor modifications, if necessary (Table 1). For structures, the occupants and materials would be relocated to alternative structures, traffic would use alternate routes, and utility services would be provided by alternative methods. This action would not entail any major physical construction or addition to the existing facility and, if any work is required, it would consist of only minor modifications. For properties in the hazard area, FEMA would acquire damaged properties, demolish existing structures, and place deed restrictions that would limit future uses to open space in perpetuity.

1.3.4.3 Actions Involving Watercourses and Coastal Features

Many FEMA activities pertain to inland water sources, such as streams, rivers, and lakes, and coastal features, such as harbors and beaches. Inland water sources may be perennial or dry during the summer months. Such projects may qualify as Standard Actions (Table 1). During construction, avoidance and minimization measures would be used and incorporated as part of the action. These typical measures are described in Section 1.3.9. Work in a stream channel often includes temporary diversion of the channel using sandbags or a cofferdam constructed of fill. Heavy equipment is typically operated from an adjacent road, bank, or other feature; however, in

[2] Utilities refer to water, sewer, natural gas, and power/electrical systems and similar types of infrastructure.

some cases, operating equipment in a channel area once flow has been diverted may be necessary. A pipe or a temporary secondary channel may be used to convey the diverted water.

If the action involves channel modifications, changes to the capacity of bridges and culverts, or the installation of attenuation structures, FEMA would conduct hydraulic/hydrologic analyses to evaluate the changes of upstream and downstream flow rates and determine whether additional action components need to be added to address any changes in hydraulics and hydrology outside the project area may be necessary.

Relevant categories of activities include the following:

- Repairing, stabilizing, or armoring embankments;
- Constructing or modifying an existing water crossing; and
- Constructing or modifying an existing coastal feature, such as groins, jetties and revetments.

During construction, avoidance and minimization measures would be used and incorporated as part of the action (see Section 1.3.9 Avoidance and Minimization Measures).

1.3.4.3.1 Repairing, Stabilizing, or Armoring Embankments

Repairing, stabilizing, or armoring embankments would involve the repair of earthen or rock embankments damaged by floodwaters. Such projects may qualify as Standard Actions (Table 1). Examples are natural stream banks (such as those in parks); road, trail, and rail line embankments; embankments for irrigation and navigation canals; and levees used for flood control and reclamation. In addition to repair of damaged features, FEMA may fund measures designed to prevent damage in future flood events.

Proposed streambank stabilization methods include alluvium placement, vegetated riprap with large wood (LW), log or roughened rock toe, woody plantings, herbaceous cover, deformable soil reinforcement, coir logs, bank reshaping and slope grading, floodplain flow spreaders, floodplain roughness, and engineered log jams (ELJs), alone or in combination.

1.3.4.3.2 Constructing a Water Crossing

As a Standard Action, FEMA may fund the repair or replacement of damaged water crossings, the enlargement of openings to allow greater conveyance and reduce the risk that debris would get trapped during floods, or the installation of bank protection or other means to reduce the risk of erosion (Table 1). Crossings may also be relocated or improved to avoid high-hazard areas, repetitive damage, or areas where reconstruction is not cost-effective or feasible.

Culverts may consist of corrugated metal pipes, reinforced concrete pipes, or reinforced concrete box culverts. The capacity of a culvert crossing may be increased to reduce the risk of flooding to the surrounding area, or the culvert may be modified to prevent overtopping or erosion of the crossing. Typical measures would include:

- Increasing the size of a culvert or adding culvert barrels;
- Changing the type of culvert; and
- Changing the location or alignment of a culvert.

Similarly, bridges may be modified to increase capacity to reduce the risk of flooding or to reduce the risk of damage to the crossing. Typical activities would include:

- Widening existing openings or constructing new openings;
- Reconfiguring bracing to reduce the risk that debris would be trapped; and
- Replacing a multi-span structure with a clear-span structure.

A bridge may be installed to replace a culvert to increase the flow capacity of a crossing.

1.3.4.3.3 Repairing an Existing Coastal Feature

Constructing a coastal feature would involve the repair or replacement of facilities in coastal environments, such as estuaries, inlets, harbors, and beaches. Such projects may qualify as Standard Actions (Table 1). These facilities include:

- Recreational facilities, such as piers and boat ramps;
- Facilities for maritime use, such as docks and slips;
- Shoreline protection devices, such as seawalls, groins, jetties, and revetments; and
- Coastal flood-control structures, such as levees.

Construction activities would be expected to occur in water and involve driving piles, placing rock or soil, or dredging sand, mud, or other sediment.

1.3.4.4 Wildfire Risk Reduction

Vegetation management is intended to reduce the risk of loss and damage due to wildfire as described in Section 3.3. Vegetation management for wildfire risk reduction may be accomplished using mechanical means, hand-clearing, or grazing. Some activities may include a combination of these methods. Such projects may qualify as Standard Actions (Table 1). During construction, avoidance and minimization measures would be used and incorporated as part of the action (see Section 1.8 Avoidance and Minimization Measures).

Relevant categories of activities include

- Mechanical or hand clearing of vegetation, and
- Biological control.

1.3.4.4.1 Mechanical or Hand Clearing of Vegetation

Mechanical or hand clearing of vegetation would be used for the selective removal of vegetation so that a certain proportion of vegetation is left in place. This would be done to reduce the amount of vegetative fuels in an area where mechanical removal of vegetation is impractical or the remaining vegetation needs to be protected. Per FEMA's Wildfire Mitigation Policy (MRR-2-08-1) vegetation may be removed to create defensible space around buildings and structures, and to protect life and property beyond defensible space perimeters but proximate to (less than 2 miles from) at-risk structures. Such projects may qualify as Standard Actions (Table 1). The creation and maintenance of firebreaks, access roads, and staging areas is not eligible for FEMA funding.

In mechanical removal, heavy equipment would be used to uproot, crush, pulverize, or cut the trees and brush being removed. Hand removal would involve the use of chainsaws, axes, and hoes to cut and uproot vegetation. Depending on the location of the vegetation removal project and State and local regulations, vegetation downed as a result of mechanical or hand removal would be piled and burned on site, chipped and spread on site, or loaded and hauled away from the site. After the removal of the targeted vegetation, cleared areas would be revegetated with native, fire-resistant species. Vegetation hauled off-site could be recycled but must be disposed of in accordance with appropriate requirements.

1.3.4.4.2 Biological Control

In biological control, cattle, horses, goats, sheep, or other livestock would be allowed to graze on grasses and other vegetation as a means of control. The area proposed for grazing would be fenced. The type of animals, timing, duration, and stocking rate would be selected based on the targets of the vegetation management plan (i.e., the quantity and quality of residue to remain).

Table 1. Summary of Standard Actions and Framework Actions

Project Types	**Standard Actions**	**Framework Actions**
Non-Emergency Debris Removal		
Non-Emergency Debris Removal	• Removing woody debris and other vegetation from events that damage or destroy trees • Removing rock and earth from landslides caused by events such as earthquakes or heavy rains • Removing rubble after earthquakes • Removing rock, silt, sediment, or woody debris that floodwaters have deposited in harbors and ports, stream channels, bridge and culvert openings, canals, sedimentation basins, sewage treatment ponds, ditches, and other structures in such a manner as to disrupt normal flows, navigation, recreation, or municipal services • Hauling and disposing of debris	NA
Constructing, Modifying, or Relocating Facilities		
Airport Runway Construction	NA	• Repairing or realigning airport runways and associated structures • Constructing of new airport runways and associated structutres • Managing and/or removing wildlife
Road and Trail Construction	• Constructing or realigning existing roads, trails, or boardwalks • Repairing or replacing damaged roads and trails; including retaining walls, subsurface, and pavement • Regrading or improving existing gravel or dirt roads and trails • Repairing an existing low-water road crossing[3]	• Constructing new roads, trails, or boardwalks

Project Types	Standard Actions	Framework Actions
Utility Construction	• Constructing, repairing, or relocating existing utility pipelines (e.g., potable water, sewer pipelines, natural gas, petroleum), leach fields, wastewater hookups, electrical lines (including street lighting), and telephone lines that have been damaged in floods or fires • Constructing, repairing, or relocating existing substations or other utility infrastructure • Constructing or installing temporary utilities including associated infrastructure • Installing electrical boxes for electrical transformers and switches and secondary utility boxes for telephone and cable	• Constructing new utility pipelines (e.g., potable water, sewer pipelines, natural gas, petroleum), leach fields, wastewater hookups, electrical lines (including street lighting), and telephone lines that have been damaged in floods or fires
Rail Line Construction	• Acquiring or decommissioning of an existing rail line • Realigning or modifying an existing rail line • Repairing or replacing ballast and track • Stabilizing embankments along a rail line corridor • Repairing or replacing fill using rock, grout, timber walls, or steel sheet piling • Repairing or replacing earthen material lost during disasters	NA
Facility Disaster Mitigation Activities[1]	NA	• Modifying structures to reduce the risk of damage during floods by elevating structures above the expected flood level or by flood-proofing • Making structures more fire-resistant by replacing roofs, doors, and other building components with fire-resistant materials • Installing bracing, shear panels, shear walls, anchors, or other features so that structures are better able to withstand disaster events such as those associated with seismic, high wind events, or snow loads

Project Types	Standard Actions	Framework Actions
Building and Facility Construction	NA	• Installing prefabricated manufactured structures (or temporary structures) including dwelling pads • Constructing safe rooms • Modifying existing buildings to serve as temporary housing • Acquiring and demolishing existing structures and buildings located in high-hazard areas • Constructing, repairing, or relocating new infrastructure (e.g., wastewater treatment plants, public buildings, and certain utilities)
Actions Involving Watercourses and Coastal Features		
Stormwater Management	NA	• Constructing, repairing, replacing, or modifying a stormwater management structures and associated infrastructure, including storm drains, pipelines, and outfalls.
Flood Control Activities	• Dredging of sediment and debris from existing flood control structures • Removing vegetation, rock, silt, or woody debris from flood control structures • Repairing existing levees and floodwalls	• Constructing, repairing, and realigning drainage swales, earthen channels, concrete channels, or subsurface concrete pipelines • Constructing, repairing, or replacing earthen banks or channel • Constructing or modifying levees and floodwalls
Culvert Construction	• Increasing the size of an existing culvert or adding culvert barrels • Constructing, repairing, replacing, or realigning a culvert or associated structure • Constructing box culverts • Modifying the type of culvert • Adding features to an existing culvert, such as a headwall, discharge apron, or riprap[2], to reduce the risk of erosion or damage to a culvert	NA

Project Types	Standard Actions	Framework Actions
Bridge Construction	• Increasing capacity to reduce the risk of flooding or to reduce the risk of damage to the crossing • Widening existing openings or constructing new openings • Reconfiguring bracing to reduce the risk that debris would be trapped • Installing protective features, such as concrete abutments or riprap[2], to reduce the risk of damage due to erosion and scour • Repairing an existing bridge structure, including from large bridges to pedestrian bridges • Replacing a multi-span structure with a clear-span structure	NA
Bank Protection, Stabilization, and Erosion Control Activities	• Repairing or replacing existing or placing new rock riprap[2] within stream channels, banks, or hillsides • Repairing or replacing existing or installing new retaining walls, or geotextile fabrics • Constructing, repairing, or replacing bank protection, stabilization, and erosion control by using bioengineering techniques (e.g., planting vegetation, placing root wads, or placing willow bundles)	• Repairing or replacing existing or hardening new areas with concrete or soil cement
Detention/Retention, or Basin Water Storage Facility Construction	• Repairing or replacing existing detention/retention basins, or sediment ponds	• Constructing new detention/retention basins or sediment ponds
Linear Water Conveyance Facility Construction	• Repairing or replacing irrigation ditches, canals, or flumes, and associated infrastructure	• Constructing or modifying irrigation ditches, canals, or flumes, and associated infrastructure
Shoreline Facilities - Recreational or Maritime Use	• Repairing or replacing existing boardwalks, piers, boat ramps, docks, and slips	• Constructing new boardwalks, piers, boat ramps, docks, and slips

Project Types	Standard Actions	Framework Actions
Shoreline Facilities – Protection	• Repairing existing seawalls, groins, jetties, revetments, levees, dikes, and floodwalls • Repairing interior drainage systems to reduce the risk of damage behind levees and floodwalls during heavy rains or flooding events on streams • Repairing existing bank protection of a shoreline structures • Repairing damaged shoreline structures	• Constructing, replacing, or modifying seawalls, groins, jetties, revetments, levees, dikes, and floodwalls • Modifying or installing interior drainage systems to reduce the risk of damage behind levees and floodwalls during heavy rains or flooding events on streams • Modifying or installing new bank protection of a shoreline structures • Raising the height of existing structures to prevent overtopping in future floods
Wildfire Risk Reduction		
Defensible Space Creation and Hazardous Fuels Reduction	• Mechanical or hand-clearing of vegetation to reduce the amount of vegetative fuels in an area • Removing vegetation to create defensible space around buildings and structures • Preventing re-growth and re-sprouting of undesirable vegetation once an area has been cleared of excessive vegetation by mechanical means and/or hand removal • Grazing of cattle, horses, goats, sheep, or other livestock on grasses and other vegetation as a means of control	NA

Notes:

1 Project types may include development of demonstration projects of a natural disaster (*i.e.*, severe rain, flood, wildfire, wind, and earthquake) for public education and/or training purposes.
2 Utilization of riprap and concrete without bioengineering and vegetation is not covered under this BO
3 Culvert repairs, bridge repairs, and other water crossing repairs must meet the NMFS Guidelines for Salmonid Passage at Stream Crossings, included in Appendix B, or subsequent version

1.3.5 Not Included in this BO

This BO does not cover any actions that would necessitate emergency ESA consultations.

1.3.5.1 Emergency ESA Consultations in California

Section 7 of the ESA recognizes that emergencies (such as a disaster) involve situations which do not allow for normal consultation procedures to be followed. For example, some emergencies may require expedited consultation (50 CFR § 402.05). These ESA provisions allow for actions to be taken under an emergency situation to protect from the loss of human life and/or property, in coordination with proper notification to the USFWS and/or NMFS, and follow up with an after-the-fact consultation. This BO does not cover emergency situations or emergency consultations, as those would follow the standard procedures outlined under 50 CFR § 402.05.

1.3.6 Process for ESA and MSA Compliance

First, FEMA would determine if the project meets the suitability criteria for coverage under this programmatic consultation, described in Sections 1.3.7 and 1.3.8. If FEMA finds that an individual project qualifies for inclusion into FEMA's programmatic consultation for Disaster, Mitigation and Preparedness Programs in California as a Standard Action, FEMA will transmit that finding to NMFS using the ESA/MSA Review Form. An ESA/MSA Review Form (Appendix A) has been created for reporting the potential effects of covered projects to NMFS. FEMA would complete this form for proposed projects that could be covered under this programmatic consultation and submit the form to NMFS, requesting coverage. If NMFS agrees that the project qualifies, FEMA will not need to initiate individual consultation for such projects because their effects have been analyzed in this programmatic biological opinion. NMFS would confirm by email that the project is covered under this programmatic consultation as a Standard Action.

For Framework Actions included in FEMA's Disaster, Mitigation and Preparedness Programs in California, FEMA would determine if the proposed project meets the suitability criteria for ESA and/or MSA coverage. If the suitability criteria for ESA and/or MSA coverage are met, FEMA would determine whether the proposed project has the potential to adversely affect federally listed species, their critical habitat, and/or EFH covered in this BO. All Framework Actions will require additional consultation. Framework Actions that are “not likely to adversely affect” listed species may be covered through NMFS concurrence under this BO; the ESA/MSA Review Form may serve as the initiation package for these projects. Framework Actions that cause adverse impacts resulting in “take” are not covered under the incidental take statement for this consultation. For those actions, FEMA would submit the ESA/MSA Review Form with a streamlined biological assessment to NMFS and request a streamlined consultation. NMFS would then issue a streamlined BO.

If a proposed project does not meet the suitability criteria established in this BO, FEMA would request a separate individual consultation under the MSA and/or Section 7 of the ESA for that specific project.

1.3.7 FEMA's Proposed Suitability Criteria for ESA Coverage

As described in Section 1.4.2.1 in the PBA, FEMA has executed a Memorandum of Understanding (MOU) with USACE, the U.S. Fish and Wildlife Service (USFWS), and NMFS for FEMA-funded projects in California, Nevada, and Arizona. As stipulated in the MOU, FEMA is typically the Lead Federal Agency for FEMA-funded projects receiving USACE authorization through a Nationwide Permit (NWP) or Regional General Permit (RGP) issued by USACE under Section 404 of the Clean Water Act (CWA) or projects that do not require a Section 404 CWA permit. Since the MOU stipulates that the USACE would be the Lead Federal Agency for larger or more complex projects requiring an Individual Permit from USACE under Section 404 CWA, such projects would not be covered by this BO between NMFS and FEMA.

There are limitations placed on and general condition requirements for projects authorized through the NWP program by project type, as detailed in the 2017 USACE guidelines for NWPs (82 FR 1860). Similarly, RGPs place limitations on the geographic location, size, and scope of projects they cover. Some NWP authorizations only cover projects that have a disturbance footprint of 0.5 acre or less of waters of the U.S. including wetlands, and disturbance up to 500 linear feet or less of banks. For this BO, FEMA is adopting these limits and applying them more broadly to all project types.

This programmatic consultation does not provide ESA coverage for the recipient's (subapplicant) proposed projects that involve the following activities:

- Work that results in any adverse effects on federally listed species under NMFS jurisdiction that are not covered under this BO (i.e., marine mammals, sea turtles, white abalone) and/or their critical habitat, including any adverse effects to these species, including but not limited to take of such species (injury or mortality, capture and relocation, harassment), and habitat modification or degradation that could impair biological function such as breeding, feeding, or sheltering;

- A situation in which a subapplicant cannot or is not willing to implement the applicable avoidance and minimization measures included in this BO;

- Using pesticides, herbicides, or flame retardants in areas supporting listed species or their critical habitat;

- Blasting activities in areas supporting listed species or their critical habitat;

- Installing ***new*** outfalls (a point source as defined by 40 CFR 122.2) or water intakes in areas supporting listed species or their critical habitat, or areas directly connected to such areas (modifying and repairing outfalls may be covered);

- Altering existing water intakes in a manner that changes the ***capacity*** of the structure in areas supporting listed species or their critical habitat(the repair or replacement of existing intakes may be covered, but operation of the water intake would require a separate consultation);

- Repairing or replacing intakes that are ***not properly screened*** in accordance with NMFS fish screening criteria (NMFS 1997);
- Altering culverts and other water crossings in a manner that ***reduces*** the ability to pass migrating listed species (Note that culvert repairs, bridge repairs, and other water crossing repairs must meet the *NMFS Guidelines for Salmonid Passage at Stream Crossings*, included in Appendix B, or subsequent version);
- Construction of new or replacement of permanent low water crossings;
- ***Dredging (either for new construction or maintenance)*** in channels, open water bays, or estuaries; however, projects that involve the removal of disaster-related sediment or debris from waterways may be covered under this programmatic consultation;
- Creating a new water crossing structure (e.g., bridges and culverts), for which the recipient's (subapplicant) design ***cannot meet fish passage criteria*** established in NMFS guidelines (Appendix B, or subsequent version) or other applicable regional guidance such as the California Salmonid Stream Habitat Restoration Manual;
- The installation or replacement of riprap or other bank stabilization in suitable habitat or critical habitat for listed species that ***does not*** include the incorporation of bioengineering techniques or other design elements (see Appendix E for references and guidance) that provide for the establishment of appropriate wetland or riparian vegetation on the stabilized bank[3];
- Removing[4] woody riparian vegetation[5] within suitable habitat or critical habitat (proposed or designated) for listed species during project construction, ***without*** implementation of AMM-25, Revegetation of Stream Banks (Note that this does not apply to vegetation removed by disaster or the clearing of vegetative debris deposited by disaster),
- Conducting in-water work ***outside*** of the work windows specified in Appendix C;

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[3] For projects on Levees within the Central Valley, projects that implement the Vegetation Management Strategy of the Central Valley Flood Protection Plan (CVFPP) Conservation Strategy (DWR 2017) would meet this criterion. The Vegetation Management Strategy referenced allows for managed tree growth on the lower waterside slope of levees.

[4] Removal of vegetation refers to the removal woody riparian vegetation (as defined in the next footnote) as a result of project activities, including project construction, access routes, construction staging areas, and any other activities resulting from implementation of the funding recipient's (subapplicant) proposed project. Minor trimming of vegetation to allow for construction access is not considered "removal", as long as the trimming does not reduce canopy shade or impact survival of the trimmed vegetation.

[5] "Woody riparian vegetation" includes riparian trees and shrubs that are supported by perennially growing woody stems. Annuals, biennials, and perennials plants that overwinter via rootstocks (such as blackberry and reed grass) are not considered woody riparian vegetation.

- Construction of ***new*** dams, flood channels, water diversion structures, spillways, and other flood control stuctures such as levees and floodwalls (the construction of coastal flood control structures may be allowed);

- Projects that have disturbance areas ***greater than*** 0.5 acre of waters of the U.S. including wetlands, and/or disturbance of ***more than*** 500 linear feet of streambank and/or shoreline. NMFS may waive this limitation if FEMA has adequately demonstrated that the recipient's (subapplicant) proposed project would have effects that are insignificant, discountable, or wholly beneficial.

If a proposed project includes any of these activities, it would not be covered under this programmatic consultation, and may require an individual ESA consultation separate from this BO.

1.3.8 FEMA's Proposed Suitability Criteria for MSA Coverage

This BO does not provide MSA coverage for individual projects that involve the following activities:

- Using pesticides, herbicides, or flame retardants in areas designated as EFH;

- Blasting activities in EFH;

- Installing new outfalls (a point source as defined by 40 CFR 122.2) or intakes in EFH or areas connected to EFH;

- Altering existing intakes in a manner that changes the capacity of the structure in EFH. (The repair or replacement of existing intakes may be covered, but any consultation requirements for operation of the intake would require a separate consultation);

- Dredging (either for new construction or maintenance) in channels, open water bays, or estuaries; however, projects that involve the removal of disaster related sediment or debris from waterways may be covered under this BO;

- Construction of new dams, flood channels, water diversion structures, spillways, and other flood control structures such as levees and floodwalls (the construction of coastal flood control structures may be allowed);

- A situation in which the subapplicant cannot or is not willing to implement the applicable avoidance and minimization measures included in this BO, or suitable alternatives approved by NMFS, knowing that the implementation of those measures would avoid, minimize, or otherwise offset adverse effects to EFH; and

- Projects that have disturbance areas greater than 0.5 acre of waters of the U.S. including wetlands, and/or disturbance of more than 500 linear feet of streambank and/or shoreline. NMFS may waive this limitation if FEMA has adequately demonstrated that the recipient's (subapplicant) proposed project would have effects that are insignificant, discountable, or wholly beneficial.

Projects that do not meet the suitability criteria listed above would require an individual consultation outside of this BO to comply with the MSA.

1.3.9 Avoidance and Minimization Measures

This section describes avoidance and minimization measures that would be implemented to reduce the identified potential adverse effects from a subapplicant's proposed project. FEMA would be responsible for ensuring that each recipient (subapplicant) implements the avoidance and minimization measures identified as necessary for the proposed project.

1.3.9.1 General Construction Measures

AMM-1: Erosion and Sedimentation Prevention Measures

For projects that have the potential to cause erosion and introduce sedimentation into waters, wetlands, and riparian areas supporting listed species, the recipient (subapplicant) would prepare an Erosion Control Plan. The Erosion Control Plan would detail the erosion and sedimentation prevention measures required. As part of this plan, the recipient (subapplicant) would ensure that temporary sediment-control devices are installed and maintained correctly. For example, sediment would be removed from engineering controls once the sediment has reached one-third of the exposed height of the control. The devices would be inspected frequently (i.e., daily or weekly, as necessary) to ensure that they are functioning properly; controls would be immediately repaired or replaced or additional controls would be installed as necessary. Sediment that is captured in these controls may be disposed of onsite in an appropriate, safe, approved area or offsite at an approved disposal site.

Areas of soil disturbance, including temporarily disturbed areas, would be seeded with a regionally appropriate erosion control seed mixture. On soil slopes with an angle greater than 30%, erosion control blankets would be installed or a suitable and approved binding agent would be applied. Runoff would be diverted away from steep or denuded slopes.

Where habitat for listed fish species is identified within, or adjacent to, the project footprint, all disturbed soils at the site would undergo erosion control treatment before the rainy season starts and after construction is terminated. Treatment may include applying temporary native or non-native sterile-seed mix, weed-free certified straw mulch, jute matting, and similar materials.

AMM-2: Bank Stabilization

If bank stabilization activities, such as the placement of rock slope protection, are necessary, then such stabilization would contain bioengineering or design elements suitable for supporting riparian vegetation (See Appendix E), and would be constructed to minimize erosion downstream potential. The use of gabions for streambank stabilization is prohibited in this program. In areas that support juvenile salmonid rearing, bank stabilization projects would incorporate habitat enhancement features such as wood, boulders, and vegetation for habitat complexity to the extent feasible. Depending on the project site, the following streambank stabilization and habitat enhancement features may be used individually or in combination:

a. Alluvium placement –Using imported gravel-, cobble-, and boulder-sized material of the same composition and size as that in the channel bed and banks, to halt or attenuate streambank erosion, and stabilize riffles. This method is predominantly for use in small to moderately sized channels and is not appropriate for application in mainstem systems. Alluvium placement provides roughness, redirect flow, and provide stability to adjacent streambed and banks or downstream reaches, while improving fish habitat.

    1. When filling scour holes or constructing footings, facing or other protection using rock to prevent scouring or other erosive action, the amount of rock used would be limited to the minimum necessary to protect the integrity of the structure. Whenever feasible, include soil and woody vegetation as a covering and throughout the structure.

    2. Material used to construct the toe should be placed in a manner that mimics attached longitudinal bars or point bars. Size distribution of toe material would be diverse and predominately comprised of D_{84} to D_{max} size class material.

    3. Spawning gravels would constitute at least one-third of the total alluvial material used in the design, would be placed at or below an elevation consistent with the water surface elevation of a bankfull event, and can be used to fill the voids within toe and bank material and placed directly onto stream banks in a manner that mimics natural debris flows and erosion.

    4. All material would be clean alluvium with similar angularity as the natural bed material. When possible use material of the same lithology as found in the watershed. Reference *Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings* (USDA-Forest Service 2008) to determine gravel sizes appropriate for the stream. Crushed rock is not permitted.

    5. Material can be mined from the floodplain at elevations above bankfull, but not in a manner that would cause stranding during future flood events.

    6. Material would not be placed directly on bars and riffles that are known spawning areas, which may cause fish to spawn on the unsorted and unstable gravel, thus potentially resulting in redd destruction.

    7. Imported material would be free of invasive species and non-native seeds. If necessary, wash prior to placement.

b. Large wood placement – Structures composed of large wood that do not use mechanical methods as the means of providing structure stability (i.e., large rock, rebar, rope, or cable). The use of native soil, alluvium with similar angularity as the natural bed material, or buttressing with adjacent trees as methods for providing structure stability may be utilized. This method is predominantly for use in small to moderately sized channels and is not appropriate for application in mainstem systems. These structures are designed to provide roughness, redirect flow, and provide stability to adjacent streambed and banks or downstream reaches, while providing valuable fish habitat.

1. Structure shall simulate natural disturbance events to the greatest degree possible and include, but not be limited to, log jams, debris flows, wind-throw, and tree breakage;

2. Structures may partially or completely span stream channels or be positioned along stream banks.

3. Where structures partially or completely span the stream channel, large wood should be comprised of whole conifer and hardwood trees, logs, and rootwads. Large wood size (diameter and length) should account for bankfull width and stream discharge rates.

4. Structures would incorporate a diverse size (diameter and length) distribution of rootwad or non-rootwad, trimmed or untrimmed, whole trees, logs, snags, slash, etc.

5. For individual logs that are completely exposed, or embedded less than half their length, logs with rootwads should be a minimum of 1.5 times bankfull channel width, while logs without rootwads should be a minimum of 2.0 times bankfull width.

6. Key pieces should be oriented such that the hydraulic forces upon the large wood increase stability.

c. Vegetated riprap with large wood – Combines resistive and continuous rock revetment techniques with vegetative techniques by installing a layer of stone and/or boulder armoring that incorporates vegetation and with large wood distributed throughout the structure (not just at toe). Large wood placed above the toe may be in the form of rootwad, whole trees, logs, snags, slash; whereas, large wood placed at the toe should be sturdy material, intact, hard, and undecayed and should be sized or embedded sufficiently to withstand the design flood. Space between root wads may be filled with large boulders, whole trees, logs, snags, slash, etc. Woody vegetation such pole planting, live staking and plantings should be planted in joints between the rocks.

1. The minimum amount of wood incorporated into the treated area, for mitigation of riprap, is equal to the number of whole trees whose cumulative summation of rootwad diameters is equal to 80% of linear-feet of treated streambank or 20% of the treated area (square feet) of streambank, whichever is greater.

2. Where whole trees are not used (i.e., snags, logs, and partial trees) designers are required to estimate the dimensions of parent material based on rootwad diameter, and calculating a cumulative equivalency of whole trees.

d. Roughened rock toe – Structural features that prevent erosion at the toe of a streambank, which is the location where erosional forces are greatest. They provide rock armoring at the most vulnerable point of the streambank while still allowing more natural techniques such as planting to be used on the upper streambank. Large woody debris can be incorporated into this technique to improve habitat value and further decrease water velocities adjacent to the bank. Similar to riprap, roughened rock toe would reduce sediment recruitment from the streambank, protect vegetation from erosion, and provide large woody debris recruitment.

1. Since larger rock is assumed to have greater habitat value and energy dissipation, rock toes should include rock along the toe line that is larger than that which is required to resist erosion alone. Similarly, large rock should be used when large woody debris is incorporated into the design to help secure the debris.

2. The rock toe should be installed at least to an elevation that corresponds with the lower limit of vegetation on a streambank or the ordinary high-water mark. Although on high-shear-stress banks, the top of the rock may have to be located higher on the bank than in streams with lower flood depth and lower slope.

3. Large woody debris placed into rock toes should be designed to withstand buoyancy and rotational forces. The debris must be well anchored into the rock to eliminate the risk of the buoyancy or leverage causing the debris to pull free and impact the integrity of the toe. Large woody debris installed in rock toes should be positioned such that it provides cover and has the potential to collect additional debris and bed material.

4. Natural hard points, such as large, stable trees or rock outcroppings, are natural places to begin or end the toe. Begin and end toe protection outside the area of bank erosion. An anchor point (a rock- or log-filled trench placed perpendicular to the toe and cut back into the bank) must be located at the upstream and/or downstream ends of the project to prevent flow from eroding behind the toe. Should the biotechnical bank protection above the toe fail, the anchor points guide the flow out from behind the toe and back into the channel. Without these trenches, the river could easily scour behind the toe along its length and cause bank failure.

e. Woody plantings – Bank-stabilization technique that relies on planted trees and shrubs to stabilize eroding banks, provide habitat benefits and improve aesthetics. Commonly used woody plantings include live cuttings, especially those from willows, because of their ability to root well from locally collected, dormant cuttings and to colonize bare, alluvial deposits. Other woody plant materials, including containerized plants, bare-root stock and salvaged plants, are also commonly used. The following considerations should be used to determine the best option for each project:

1. Develop design criteria to identify specific requirements related to plant performance, including acceptable plant-establishment period, size of plants, growth characteristics and species diversity.

2. Conduct a site and/or reference site review to identify existing plant species, their abundance and distribution, the lower limit of perennial vegetation, the depth to groundwater, the types of soil, the availability of light, hydrology and geographic characteristics, and land use. If a reference site is used, it should preferably be in the same or nearby watershed with similar site conditions.

3. Identify and select plants with the highest likelihood of survival. Plant species native to the project area should be used, and using a broad variety of species would improve the

likelihood of project success. Plant materials can include live-rotted cuttings, bare-root stock, and container plants; if seeding streambanks, the seed should be placed under erosion-control fabric to reduce the chance of seeds washing away during flood flows.

4. Within each hydrology-based planting zone, determine planting density and layout for all plant materials; determine site-preparation requirements, timing of installation and the proper planting techniques; consider the need for maintenance such as irrigation, weed control, and the control of animal browsing.

5. Develop a post-project monitoring plan to track success/failure and to help determine maintenance activities needed to maintain healthy plant growth. Monitoring should be conducted monthly during the first full growing season after installation and can be reduced to a single, annual visit in subsequent years. In the first year after planting, it is easy to measure survival of all installed plants by a physical count; but, with increased density as vegetation fills in, it may be necessary to use cover rather than count of individual plantings as a measure of plant survival.

f. Herbaceous cover, in areas where the native vegetation does not include trees or shrubs – Upper-bank-stabilization technique that consists of planted or installed, non-woody vegetation, such as grass and grass-like wetland plants, rushes, sedges, ferns, legumes, forbs, and wildflowers designed to help prevent surficial erosion, minimize subsurface soil movement, provide wildlife habitat, and enhance aesthetics or visual appearance.

1. The same steps as outlined in the previous section (e. Woody plantings) should be followed for designing and planting herbaceous cover. Monitoring cover from the start may be more appropriate and maintenance may include mowing.

g. Bank reshaping and slope grading – Laying back or reshaping a streambank that is eroding or is susceptible to erosion without changing the location of the toe. This technique flattens or reduces the slope to stabilize the bank and is usually done in conjunction with other bank protection treatments including revegetation of an excavated bank and installation of toe protection and erosion-control fabric.

1. Designs associated with bank reshaping are site-dependent. On small creeks, or where infrastructure is not at risk, reshaped banks may be accomplished with relatively simple design and planning. In other instances, bank reshaping may require extensive analysis, design and preparation of complete plans and specifications.

2. A reshaped must transition well from adjacent treated or untreated banks so that the erosive forces of flowing water would not be concentrated on a specific area. During the design and construction phase, be sure to minimize the removal or root disturbance of existing riparian trees and shrubs since they play many important roles in stabilizing banks and providing fish habitat.

h. Coir logs – Biodegradable, manufactured, elongated cylindrical fiber rolls typically made of coconut husk fibers bound together with a coir or synthetic netting, and typically staked in a single row at the base of low (one- to three-foot-high) streambanks on small streams. Once in place, the bank behind the log can be reshaped to a stable configuration and planted with native riparian vegetation. In this configuration, the logs provide protection against hydraulic forces at the toe of the bank. Properly installed, coir logs help retain moisture and may also provide a good growth medium for riparian plants and are usually planted with herbaceous or woody vegetation.

1. Coir logs should be installed in a shallow trench that is excavated at the toe of the bank slope, and the bottom of the trench should be slightly lower than the stream bed level.

2. Place the logs in the trench such that the ends are butted firmly together. The logs should be laced together, end-to-end, with coir or synthetic rope to create a continuous length. The upstream and downstream ends of the continuous length of coir logs tend to be weak spots and should therefore be buried three to five feet laterally into the bank to protect against erosive forces.

3. When properly installed, the upper surface of the roll should be parallel to the water surface at or above the ordinary high-water line and within the zone of perennial vegetation. Cut-and-fill adjustments can be made as needed, using only hand tools wherever possible, to seat the roll so that it lies smoothly at the correct elevation.

4. Secure the coir log in the trench by driving stakes (2 x 2 x 36 inches) between the binding twine and the inner log material on either side of the log. Pairs of stakes (one stake on each side of the log) should be installed at intervals of 1 to 4 feet along the length of the log, depending upon anticipated hydraulic forces. The tops of the stakes should not extend above the top of the log. All stakes should have notches that prevent laced twine from sliding off the ends of stakes.

5. In areas that would experience wave or ice action, 16-gauge wire should be used to secure the log. To install the wire, notch the outside faces of each pair of stakes slightly below the top of the log and install the wire through the notch.

6. Once the logs are secured, soil should be backfilled on the bank side of the log, and the bank should be reshaped as necessary. Planned surface treatments and plantings should then be installed on the bank. Care should be taken to disturb as little soil as possible outside the work area and to avoid damaging any existing trees and shrubs on or near the bank.

7. Rooted herbaceous plantings should be installed into the top or sides of the coir log, or alternatively, live cuttings can be installed through the log into the underlying substrate if a means to mechanically pierce the logs is available.

i. Deformable soil reinforcement – Also called fabric-wrapped soil, soil burritos or soil pillows is a system of soil layers or lifts encapsulated or otherwise reinforced with a combination of natural or synthetic materials and vegetation. These lifts are frequently filled with fine-grained soils that would support the growth of vegetation and are most oriented along the face of a bank in a series of stepped terraces. When used with degradable fabrics, the fabric would provide one- to four-year erosion protection, giving installed vegetation the time it needs to become well established for long-term bank stabilization. In situations where increased fabric strength and longevity are needed, synthetic fabrics can be used to provide both short- and long-term structural integrity.

1. Individual soil lifts, typically 0.5 to 1.5 feet tall, can be placed in a series of lifts to create bank slopes ranging from as steep as 1:1 to flatter than 3:1, making them useful where slopes cannot be cut back. Lifts can be laid in horizontally or at a 10- to 15-degree backslope, and series of lifts can be fit to bank heights of a few feet to more than 30 feet.

2. Bank treatments longer than the width of the fabric are constructed by overlapping adjacent strips of fabric by a minimum of three feet. The upstream fabric ends of fabric rolls should overlap downstream fabric ends like roof shingles to prevent the edges from being pulled up during flood events. The bottom and top edges of fabric lifts should be buried (embedded) a minimum of three feet. Fabric can be tensioned and secured using 18- to 24-inch-long, wedge-shaped wooden stakes, placed on 3-foot centers along the upper edge and sides of a fabric wrapped lift.

3. Upstream and downstream ends of a treatment must be well-transitioned into nontreated banks and may consist of treatment ends that are keyed into the bank, covered with soil-filled riprap, or fabricated into carefully folded fabric corners.

4. A wide variety of plant materials can be used to ensure that vegetation successfully reinforces the soil lifts by the time any degradable fabric weakens. Typically, native grass seed is used because it is easily and inexpensively installed during construction and can provide both short and long-term bank reinforcement. It is also recommended cuttings of native willows or species be placed horizontally and/or vertically between lifts during construction.

5. As with any revegetation effort, plant-species selection should be based on the site hydrologic regime, soil type, and rooting and establishment patterns; and the planting should occur at the appropriate time of year.

j. Engineered log jam (ELJ) – Collection of large woody debris that redirect flow and provide stability to a streambank or downstream gravel bar. Engineered-log-jam constructions are patterned after stable, natural log jams and can be either unanchored or anchored in place using man-made materials. They are suitable for use in mainstem systems and when properly designed and located, log jams can be very stable with life expectancies equal to or greater than the design life of traditional bank protection methods.

1. The design of an engineered log jam requires a thorough analysis of channel hydraulics, which should be conducted by a qualified engineer. In naturally formed jams, the most stable configuration is one where key members are oriented parallel to the high flow, with their rootwads upstream. Racked wood is generally positioned perpendicular to the flow direction.

2. Designing an unanchored, engineered log jam requires excavating the streambed to provide a trench for the key member(s). Once a key member is placed in a trench, the trench is covered with excavated sediment to provide additional ballast and frictional resistance to drag forces. Large woody material (whole trees with rootwads attached) are

stacked (stacked members) on the key members for ballast. Next, whole trees, logs and/or rootwads are racked on the upstream side of the key-piece rootwad(s).

3. For anchored log jams in small-grained substrate, log pilings can be driven vertically into the streambed using the excavator bucket. In larger substrate, pile-driving equipment may be required, as well as steel tips on the logs. The logs need to be long enough to extend below estimated scour depths. A second row of pilings should be driven into the streambed at least 20 feet downstream, and brace logs should be anchored between them. Large woody debris is then racked against the upstream side.

4. Construction should be conducted during a period where impacts to critical resident and anadromous fish life stages, such as spawning or migration, are avoided and when dewatering for construction is possible. Low-flow conditions are ideal for the placement of engineered log jams and may be essential for dewatering efforts. Dewatering eases installation and prevents siltation of the stream during construction.

k. Floodplain flow spreaders – Trees, large woody debris, or rock immobile rock placed in a series of rows perpendicular to the direction of overland flow to form small dams that are porous and collect debris and that dissipate flow energy and distribute the flow across the floodplain. This technique is suitable for use in mainstem systems.

1. The critical design parameter of a floodplain flow spreader is the base elevation of the structure and depth of flow on the floodplain at the flood event of interest; so the top of the spreader should be at or near the flood-event elevation, with allowances for increased stage due to backwatering caused by the spreader itself.

2. To ensure even distribution of water across the width of the floodplain, the elevation of the top of the spreader must be uniform across its length (cross valley direction).

3. The width (down-valley dimension) of the structure should be equal to (at a minimum) the depth of installation (predicted scour). If scour depth cannot be predicted, the width of the structure should be twice the diameter of the largest rock gradation.

4. Flow spreaders should be tied in to higher ground to prevent water from flowing around the spreader and scouring at the margins of the spreader.

5. Flow spreaders can be constructed from live trees, rock, soil, wood or other hard material. Alternatives include vegetated soil berms, wooden sills, or piles of large woody debris. Soil berms would require erosion protection in the form of fabric to hold soils in place while vegetation becomes established.

6. While the spreader may be constructed of rock, it would be difficult to achieve uniform elevation across its length with larger rock. Rock must not be so small that it is subject to entrainment due to tractive forces at the design flood event. Rock should be placed in a stable configuration and keyed in below the floodplain surface to the depth of potential scour. Graded rock would allow interlocking of individual stones and should be sized such that the D50 is immobile at design flows

l. Floodplain roughness – Preventative technique used to decrease overbank flow velocity and related shear stress by placing large woody debris and or vegetative roughness elements in the floodplain perpendicular to the predicted overbank flow direction at the locations where an avulsion or cutoff is likely to form. A combination of riparian plantings, live brush rows, and large woody debris can be used individually or in combination. Suitable for mainstem systems.

   1. Native riparian plantings are densely planted in a random pattern on the floodplain, and it is recommended that various configurations of live cuttings be oriented into multiple rows (live brush rows).

   2. Multistemmed shrubs are preferable over single stemmed trees, since they tend to disperse flood flows and encourage sediment deposition. The use of live cuttings is preferable over container or bare-root plants since they can be planted deep enough to reach the water table and are less prone to washout during flood flows.

   3. Large woody debris may need to be anchored to the floodplain if high shear stresses are anticipated during design flood flows. Large woody debris with intact branches is preferable, since the branches provide greater roughness than a bare tree trunk does. If this is not available, an alternative is to cable multiple bare logs together into a matrix configuration to simulate a tree with intact branches.

For more information on the above methods see FEMA (FEMA 2009) Engineering with Nature, Natural Resources Conservation Service (NRCS 2016) Natural Channel and Floodplain Restoration, Applied Fluvial Geomorphology (NRCS Website), or Integrated Streambank Protection Guidelines (Cramer *et al.* 2003). Other than those methods relying solely upon woody and herbaceous plantings, streambank stabilization projects must be designed by a qualified engineer that is appropriately registered in California.

AMM-3: Dust Control Measures

To reduce dust, all traffic associated with the recipient's (subapplicant) construction activities would be restricted to a speed limit of 20 miles per hour when traveling off of highways or county roads.

Stockpiles of material that are susceptible to wind-blown dispersal would be covered with plastic sheeting or other suitable material to prevent movement of the material.

During construction, water or other binding materials would be applied to disturbed ground that may become windborne. If binding agents are used, all manufacturer's recommendations for use would be followed, and the following restrictions would be utilized:

a. Do not use petroleum-based products.

b. Do not apply dust-abatement chemicals, e.g., magnesium chloride, calcium chloride salts, ligninsulfonate, within 25 feet of a water body, or in other areas where they may runoff into a wetland or water body.

c. Do not apply ligninsulfonate at rates exceeding 0.5 gallons per square yard of road surface, assuming a 50:50 solution of ligninsulfonate to water.

AMM-4: Spill Control Planning

A Spill Prevention and Pollution Control Plan would be prepared to address the storage of hazardous materials and emergency cleanup of any hazardous material and would be available onsite. The plan would incorporate hazardous waste, stormwater, and other emergency planning requirements.

AMM-5: Spill Prevention and Pollution Control Measures

The recipient (subapplicant) would exercise every reasonable precaution to protect listed species and their habitats from pollution due to fuels, oils, lubricants, construction by-products, and pollutants, such as construction chemicals, fresh cement, saw-water, or other harmful materials. Water containing mud, silt, concrete, or other by-products or pollutants from construction activities would be treated by filtration, retention in a settling pond, or similar measures. Fresh cement or concrete would not be allowed to enter the flowing water of streams and curing concrete would not come into direct contact with waters supporting listed species. Construction pollutants would be collected and transported to an authorized disposal area, as appropriate, per all Federal, State, and local laws and regulations.

To reduce bottom substrate disturbance and excessive turbidity, removal of existing piles by cutting at the substrate surface or reverse pile driving with a sand collar at the base to minimize resuspension of any toxic substances is preferable. Hydraulic jetting would not be used.

No petroleum product chemicals, silt, fine soils, or any substance or material deleterious to listed species would be allowed to pass into or be placed where it can pass into a stream channel. There would be no side-casting of material into any waterway.

If drilling or boring are used in a wetted channel or open water, the drilling operations would be isolated using a steel casing or other appropriate isolation method to prevent drilling fluids from contacting water. All drilling fluids and waste would be recovered and recycled or disposed of to prevent entry into flowing water.

All concrete or other similar rubble would be free of trash and reinforcement steel. No petroleum-based products (e.g., asphalt) would be used as a stabilizing material.

The recipient (subapplicant) would store all hazardous materials in properly designated containers in a storage area with an impermeable membrane between the ground and the hazardous materials. The storage area would be encircled by a berm to prevent the discharge of pollutants to groundwater or runoff into the habitats of listed species.

A spill containment kit with instructions and adequate materials for spill cleanup and disposal, adequate for the types and quantity of hazardous materials, would be maintained onsite. Workers would be trained on the location of the kits and in spill containment procedures.

AMM-6: Equipment Inspection, Cleaning, and Maintenance

Before entering wetlands or working within 150 feet of a water body, all heavy equipment, vehicles and power tools, would be power washed, allowed to fully dry, and inspected for fluid leaks. After cleaning, the equipment would be inspected to make certain no plants, soil, or other organic material are adhering to the surface.

Cleaning would be repeated as often as necessary during operation to keep all equipment, vehicles, and power tools free of external fluids and grease, and to prevent a leak or spill from entering the water.

Well-maintained equipment would be used to perform the work and, except in the case of a failure or breakdown, equipment maintenance would be performed offsite. Equipment would be inspected daily by the operator for leaks or spills. If leaks or spills are encountered, the source of the leak would be identified, leaked material would be cleaned up, and the cleaning materials would be collected and properly disposed. Fueling of land and marine-based equipment would be conducted in accordance with procedures to be developed in the Spill Prevention and Pollution Control Plan.

Vehicles and equipment that are used during the course of a project would be fueled and serviced in a “safe” area (i.e., outside of sensitive habitats) in a manner that would not affect listed species, their habitats, or EFH. Spills, leaks, and other problems of a similar nature would be resolved immediately to prevent unnecessary effects on listed species and their habitats, and reported to NMFS within 48 hours.

AMM-7: Fueling Activities

Avoidance and minimization measures would be applied to protect listed species, their habitats, and EFH from pollution due to fuels, oils, lubricants, and other harmful materials. Vehicles and equipment that are used during project implementation would be fueled and serviced in a manner that would not affect listed species or their habitats. Machinery and equipment used during work would be serviced, fueled, and maintained on uplands to prevent contamination to surface waters. Fueling equipment and vehicles would occur more than 200 feet away from all aquatic resources. Exceptions to this distance requirement may be allowed for boats, large cranes, pile drivers, and drill rigs if they cannot be easily moved.

AMM-8: Equipment Staging

No staging of construction materials, equipment, tools, buildings, trailers, or restroom facilities would occur in a floodplain during flood season, even if staging is only temporary. Riparian trees and shrubs would not be removed for staging areas.

AMM-9: Materials Storage and Disposal

Stockpiled soils would be adequately covered to prevent sedimentation from runoff and wind. All hazardous materials would be stored in upland areas in storage trailers and/or shipping containers designed to provide adequate containment. Short-term laydown of hazardous materials for immediate use would be permitted provided the same containment precautions are taken as described for hazardous materials storage. All construction materials, wastes, debris, sediment, rubbish, trash, and fencing would be removed from the site once project construction is complete and transported to an authorized disposal area, as appropriate, in compliance with applicable Federal, State, and local laws and regulations. No disposal of construction materials or debris would occur in a floodplain. No storage of construction materials or debris would occur in a floodplain during flood season (See AMM-8).

Natural materials that are displaced by construction and reserved for restoration (e.g., gravel, cobble, and boulders) may be stockpiled within the floodplain and covered to avoid runoff of sediment and natural materials due to precipitation.

AMM-10: Fire Prevention

With the exception of vegetation-clearing equipment, no vehicles or construction equipment would be operated in areas of tall, dry vegetation.

The recipient (subapplicant) would develop and implement a fire prevention and suppression plan for all maintenance and repair activities that require welding or otherwise have a risk of starting a wildfire.

AMM-11: Waste Management

The work area would be kept free of loose trash, including small pieces of residual construction material, such as metal cuttings, broken glass, and hardware.

All food waste would be removed from the site on a daily basis.

All construction material, wastes, debris, sediment, rubbish, vegetation, trash, and fencing would be removed from the site once the project is completed and would be transported to an authorized disposal area, as appropriate, per all Federal, State, and local laws and regulations.

AMM-12: Work Involving Boats and Barges

For projects that involve in-water work for which boats and/or temporary floating work platforms are necessary, buoys would be installed so moored vessels would not beach on the shoreline, anchor lines would not drag. Moored vessels and buoys would not be located within 25 feet of vegetated shallow waters. Temporary floating work platforms would not anchor or ground in fish spawning areas in freshwater or in eelgrass, kelp, or macro algae. To reduce the potential for introducing aquatic invasive species, vessels would use the State's Marine Invasive Species Program, as described in AMM-24 below. Drip pans and other spill control measures would be used so that oil or fuel from barge-mounted equipment is properly contained. A spill containment kit with instructions and adequate materials for spill cleanup and disposal would be kept onboard. Workers would be trained on the location of the kit and in spill containment procedures.

1.3.9.2 Work Areas

AMM-13: Work Area Designation to Minimize Disturbance

The subapplicant would, to the maximum extent practicable, reduce the amount of disturbance at a site to the absolute minimum necessary to accomplish the project. Wherever possible, existing vegetation would be salvaged from the project area and stored for replanting after earthmoving activities are completed. Topsoil would be removed, stockpiled, covered, and encircled with silt fencing to prevent loss or movement of the soil into listed species habitats. All topsoil would be replaced in a manner to recreate pre-disturbance conditions as closely as possible.

Project planning must account for accordance with the AMMs and consider not only the effects of the action itself, but also all ancillary activities associated with the actions, such as equipment staging and refueling areas, topsoil or spoils stockpiling areas, material storage areas, disposal sites, routes of ingress and egress to the project site, and all other related activities necessary to complete the project.

Before any significant ground disturbance or entry of mechanized equipment or vehicles into the construction area, clearly mark with flagging or survey marking paint the following areas:

a. Sensitive areas, *i.e.*, wetlands, water bodies, or spawning areas, as flagged and identified by a qualified biologist.

b. Equipment entry and exit points.

c. Road and stream crossing alignments.

d. Staging, storage, and stockpile areas.

AMM-14: Access Routes and Staging Areas

When working on stream banks or floodplains, disturbance to existing grades and vegetation would be limited to the actual site of the project and necessary access routes. Placement of all roads, staging areas, and other facilities would avoid and limit disturbance to stream bank or stream channel habitat as much as possible. When possible, existing ingress or egress points would be used and/or work performed from the top of the stream banks. After construction is complete, obliteration of all staging, storage, or stockpile areas, stabilization of the soil, and revegetatation of the area would occur.[6]

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[6] Road and path obliteration refers to the most comprehensive degree of decommissioning and involves decompacting the surface, pulling the fill material onto the running surface, and reshaping to match the original contour. In some cases tillage will be necessary to decompact soils and restore infiltration ability and soil productivity. A variety of implements/methods are available to decompact soils, including: winged subsoilers, rock ripper, excavators with brush rakes, mulching heads, or custom attachments such as the subsoiling grapple rake and subsoiling excavating bucket (e.g. Ripping soils with an excavator bucket

If temporary stream crossings are needed, they would be placed outside of potential spawning habitat for listed species. Temporary bridges/plates would be extended across the channel or mats would be placed on the stream bottom to minimize disturbance. When possible, vehicles and machinery would cross streams at right angles to the main channel. After completion of the work, the temporary crossings would be removed and the contours of the streambed, vegetation, and stream flows would be returned to their pre-construction condition or better.

All staging and material storage areas, including the locations where equipment and vehicles are parked overnight, would be placed outside of the flood zone of a watercourse, above areas of tidal inundation, away from riparian habitat or wetland habitat, and away from any other sensitive habitats. When possible, staging and access areas would be situated in areas that are previously disturbed, such as developed areas, paved areas, parking lots, areas with bare ground or gravel, and areas clear of vegetation. Any road on a slope steeper than 30% would be designed by a civil engineer with experience in steep road design.

1.3.9.3 Qualified Personnel, Construction Monitoring, and Fish Relocation

AMM-15: Environmental Awareness Training for Construction Personnel

All construction personnel would be given environmental awareness training by the project's environmental inspector or biological monitor before the start of construction. The training would familiarize all construction personnel with the listed species that may occur onsite, their habitats, general provisions and protections afforded by the ESA and MSA, measures to be implemented to protect these species, and the project boundaries. This training would be provided within 3 days of the arrival of any new worker.

AMM-16: Biological Monitor

If a project involves dewatering activities, fish relocation, and/or any potential take (e.g., injury, mortality, harassment) of listed fish species, a qualified Biological Monitor would be present onsite for all construction activities that occur within 100 feet of habitats for those species. The Biological Monitor would ensure that all applicable avoidance and minimization measures in the BO are implemented during project construction. The Biological Monitor would also ensure that all vehicles entering the site are free of debris that may harbor organisms that could be introduced to the site, such as vegetation or mud from other aquatic areas. The Biological Monitor would also ensure that turbidity, sedimentation, and the release of materials such as dust or construction runoff are controlled and that spill control measures are enacted properly.

The Biological Monitor would have the authority to stop any work activities that could result in unauthorized adverse effects to listed species and/or their habitats. The Biological Monitor may

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mounted with teeth). The depth of needed tillage can be estimated by referring to the rooting depth of nearby native vegetation. In areas of dispersed soil disturbance consider spot tillage.

also conduct environmental awareness training to construction personnel prior to the start of construction.

AMM-17: Fish Relocation

If the proposed project requires in-channel work and/or channel diversion, and FEMA has determined that listed fish species have potential to occur during the construction period, fish collection and relocation would be performed.

Fish relocation would only be conducted by a qualified Fisheries Biologist and their assistants as needed. The Fisheries Biologist would have knowledge and experience in listed fish species biology and ecology, fish/habitat relationships, biological monitoring, and handling, collecting, and relocating listed fish species or other relevant experience. The biologist would relocate any stranded fish to an appropriate place depending upon the life stage of the fish and flow conditions in the vicinity. The biologist would note the number of individuals observed in the affected area, the number of individuals relocated, the approximate size of individuals, any injuries or mortalities of fish, and the date and time of the collection and relocation. This information would be reported to FEMA and NMFS. One or more of the following methods would be used to capture listed fish: electrofishing, dip net, seine, throw net, minnow trap, and hand.

For projects that require fish rescue and relocation, the recipient (subapplicant) would develop a fish relocation plan, and FEMA would submit it to NMFS for approval, and copy the Governor's Office of Emergency Services (Cal OES) on the submittal of this plan. This plan would incorporate the latest NMFS guidance relating to the electrofishing and relocation of fish[7], such as:

a. If practicable, allow listed fish species to migrate out of the work area or remove fish before dewatering; otherwise remove fish from an exclusion area as it is slowly dewatered with methods such as hand or dip-nets, seining, or trapping with minnow traps (or gee-minnow traps).

b. Fish capture will be supervised by a qualified Fisheries Biologist, with experience in work area isolation, collection of salmonids, and competent to ensure the safe handling of all fish.

c. Conduct fish capture activities during periods of the day with the coolest air and water temperatures possible, normally early in the morning to minimize stress and injury of species present.

d. Monitor the nets frequently enough to ensure they stay secured to the banks and free of organic accumulation.

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[7] At the time of publication, the most recent guidance reference is "National Marine Fisheries Service. 2000. Guidelines for electrofishing waters containing salmonids listed under the Endangered Species Act. Portland, Oregon and Santa Rosa, California."

e. Electrofishing will be used during the coolest time of day, only after other means of fish capture are determined to be not feasible or ineffective.

    1. Do not electrofish when the water appears turbid, *e.g.*, when objects are not visible at depth of 12 inches.

    2. Do not intentionally contact fish with the anode.

    3. Follow NMFS (2000) electrofishing guidelines, including use of only direct current (DC) or pulsed direct current within the following ranges:

        i. If conductivity is less than 100 microsecond (µs), use 900 to 1100 volts.

        ii. If conductivity is between 100 and 300 µs, use 500 to 800 volts.

        iii. If conductivity greater than 300 µs, use less than 400 volts.

    4. Begin electrofishing with a minimum pulse width and recommended voltage, then gradually increase to the point where fish are immobilized.

    5. Immediately discontinue electrofishing if fish are killed or injured, *i.e.*, dark bands visible on the body, spinal deformations, significant de-scaling, torpid or inability to maintain upright attitude after sufficient recovery time. Recheck machine settings, water temperature and conductivity, and adjust or postpone procedures as necessary to reduce injuries.

f. If buckets are used to transport fish:

    1. Minimize the time fish are in a transport bucket.

    2. Keep buckets in shaded areas or, if no shade is available, covered by a canopy.

    3. Limit the number of fish within a bucket; fish will be of relatively comparable size to minimize predation.

    4. Use aerators or replace the water in the buckets at least every 15 minutes with cold clear water.

    5. Release fish in an area upstream with adequate cover and flow refuge; downstream is acceptable provided the release site is below the influence of construction.

    6. Be careful to avoid mortality counting errors.

Monitor and record fish presence, handling, and injury during all phases of fish capture and submit a fish salvage report to FEMA and the FEMA Programmatic emailbox (fema.programmaticbiop@noaa.gov) within 60 days.

AMM-18: Pre-construction Surveys and Relocation of Black Abalone

For projects that require in-water work in areas supporting black abalone, pre-construction surveys for the species would be conducted if there is potential for the construction to result in injury or mortality of the species. The survey would be conducted by a qualified Biologist who has experience in visually identifying black abalone in the field and characterizing habitat parameters important for black abalone persistence no more than 30 days preceding the onset of in-water construction. The results of the preconstruction survey would be documented in a report prepared by the Biologist and submitted to NMFS for approval, and Cal OES would be copied on the submittal.

Black abalone encountered during pre-construction surveys would be reported to NMFS. If NMFS so directs, isolated black abalone (>2 meters [6.6 feet] apart from another black abalone) encountered during the pre-construction survey would be relocated to a pre-determined, NMFS-selected intertidal area containing suitable habitat. The relocation area would be as close as possible to the collection site to minimize handling time. Black abalone relocation would be performed by a qualified Biologist and would adhere to the handling protocol described for white abalone in the White Abalone Broodstock Collection and Holding Protocol (NMFS 2008b). Should a group (two or more black abalone within 2 meters [6.6 feet] of one another) of black abalone be encountered within 12.2 meters (40 feet) of the project footprint, repositioning the project footprint to avoid black abalone would be considered. If repositioning the project footprint is not feasible and if NMFS so directs, groups of black abalone may be relocated to a pre-determined, NMFS-selected intertidal area following the handling protocol described for white abalone.

1.3.9.4 Work Activities

AMM-19: Timing of In-Stream Work

All in-water construction would be planned to occur during the in-water work seasons identified in Appendix C. If any anadromous fish are expected to be present in the project footprint, work would not proceed until avoidance and/or relocation measures have been established in coordination with NMFS. All non-emergency activities capable of advanced notice would be scheduled during the work windows and during dry or low-flow periods.

AMM-20: Daily Work Hours

In-channel construction activities that could affect suitable habitat for listed fish species or EFH would be limited to daylight hours during weekdays, leaving a nighttime and weekend period of passage for the species. Work would be allowed on weekends if the proposed construction is 14 days or less in length.

AMM-21: Bridge and Culvert Design

All new or replacement bridges and culverts on anadromous-fish-bearing streams would be designed in accordance with the most current NMFS fish passage guidelines. All new stream crossings in EFH or habitat for covered anadromous fish must be able to allow passage of adult and juvenile life stages of the species. All culvert stream crossings, regardless of the design option used, would be designed to allow passage of the 1-percent-annual-chance flood discharge without structural damage to the crossing. The analysis of the structural integrity of the crossing would take into consideration the debris loading likely to be encountered during flooding. Stream crossings or culverts located in areas where there is significant risk of inlet plugging by flood-borne debris would be designed to pass the 1-percent-annual-chance flood without exceeding the top of the culvert inlet (headwater-to-diameter ratio less than 1). This is to ensure a low risk of channel degradation, stream diversion, and failure over the life span of the crossing. Hydraulic capacity of culverts must account for expected deposition of sediments in the culvert bottom. The design would also consider climate change projections including flow magnitude and duration, and sea level rise for the life of the structure. The recipient's (subapplicant) bridge or culvert design would be submitted by FEMA along with the ESA/MSA Review Form for approval by NMFS.

1.3.9.5 Habitat Protection

AMM-22: Water Quality Protection

Contractors would exercise every reasonable precaution to protect listed species, their critical habitat, and EFH from construction byproducts and pollutants, such as construction chemicals, fresh cement, saw-water, or other deleterious materials in accordance with federal, state, and local permitting. Fresh cement or uncured concrete would not be allowed to come into contact with any waterway. Construction waste would be collected and transported to an authorized upland disposal area, as appropriate, and per Federal, State, and local laws and regulations. The recipient (subapplicant) would follow the best management practices described in *The Use of Treated Wood Products in Aquatic Environments* guidelines (NMFS 2009). Of chief concern in this guidance are the effects of the contaminants on Pacific salmonids, many of which are managed under the ESA, and the EFH provisions of the MSA. This guidance would be used in conjunction with site-specific evaluations of other potential impacts. Riprap would be clean and durable, free from dirt, sand, clay and rock fines and would be installed to withstand the 100-year flood event. If applicable, appropriate measures would be taken to minimize disturbance to potentially contaminated sediments.

AMM-23: Large Woody Material Placement

Projects in rivers may include the use of large woody material (LWM) as part of hazard mitigation, erosion control, or floodproofing. Stockpiling of LWM for later placement at stream or river projects is acceptable. LWM would be picked up and placed into the waterbody and positioned so it does not interfere with watercraft maneuvering. Anchoring techniques would be used as needed to prevent the LWM from moving during high-flow events. FEMA would be responsible for ensuring the subapplicant follow the agency guidelines on bioengineering techniques (Appendix E), as applicable.

AMM-24: Revegetation of Steam Banks

For projects that require revegetation of stream and river banks as a result of woody riparian vegetation removal during construction activities The FEMA would require the subapplicant to prepare and implement a revegetation plan that includes information regarding monitoring for success. Revegetation plantings would be replaced at a 3:1 ratio with an 80% planting survival within 5 years of the plantings. Planting or seeding would occur before or at the beginning of the first growing season after construction and include species native to the area or region. When feasible, the native vegetation would be cut off at ground level instead of grubbed, so it can potentially grow back and establish on its own, and/or the cut or grubbed vegetation would be salvaged, protected, and replanted.

Additional revegetation requirements are specified in as follows:

a. Plant and seed disturbed areas before or at the beginning of the first growing season after construction.

b. Use a diverse assemblage of vegetation species native to the action area or region, including trees, shrubs, and herbaceous species. Vegetation, such as willow, sedge and rush mats, may be gathered from abandoned floodplains, or stream channels. When feasible, use vegetation salvaged from local areas scheduled for clearing due to development.

c. For long-term revegetation use only species native to the project area or region that will achieve shade and erosion control objectives, including forb, grass, shrub, or tree species that are appropriate for the site.

d. Short-term stabilization measures may include use of non-native sterile seed mix if native seeds are not available, weed-free certified straw, jute matting, and similar methods.

e. Do not apply surface fertilizer within 50 feet of any wetland or water body.

f. Install fencing as necessary to prevent access to revegetated sites by livestock or unauthorized persons.

g. Do not use invasive or non-native species for site restoration.

Conduct post-construction monitoring and treatment to remove or control invasive plants until native plant species are well-established.

AMM-25: Invasive Plants and Aquatic Species

FEMA would ensure the subapplicant follows guidelines California Invasive Plant Council's Preventing the Spread of Invasive Plants: Best Management Practices for Land Managers (Cal-IPC 2012) to prevent the spread of invasive plant species. Construction equipment would be clean of material that may harbor invasive plant seeds or invasive pests before entering the work area. This material includes dirt or plant seeds on construction equipment, tools, boots, and clothing.

Construction equipment operating in aquatic habitat in the creeks would be closely inspected before entering the creek channel to prevent the spread of invasive aquatic species and must be completely clean and dry. Guidelines, such as those in the Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations (NWCG 2017), describe power washing and decontamination methods, and would be followed. The subapplicant would follow the guidelines in the California Department of Fish and Wildlife's (CDFW's) *California Aquatic Invasive*

Species Management Plan to prevent the spread of invasive aquatic plant and animal species (CDFW 2008).

AMM-26: Work below Mean Higher High Water

In tidally influenced estuarine and marine areas that are designated as EFH and/or may support listed species, disturbance to habitat below mean higher high water would be limited to the maximum extent possible.

AMM-27: Avoidance of Submerged Vegetation

The removal of submerged vegetation (such as eelgrass and kelp) would be avoided to the maximum extent possible. Impacts to eelgrass would require mitigation as specified in NMFS' California Eelgrass Mitigation Policy and Implementing Guidelines (NMFS 2014).

AMM-28: Minimization of Shading by Overwater Structures

To reduce shading effects, new and replacement structures placed over estuarine and marine waters (such as piers, floating docks, and gangways) would incorporate design elements (such as increased height, metal grating or glass paver blocks) that allow better light transmission consistent with the programmatic EFH consultation for overwater structures in San Francisco Bay (NMFS 2011).

1.3.9.6 Fish Species Protection

AMM-29: Fish Screening Criteria

If pumping is necessary for channel diversion, the pump intakes would be provisioned with NMFS-approved fish screening as outlined in California Department of Fish and Wildlife (CDFW) *Fish Screening Criteria* (CDFW 2001) and NMFS *Fish Screening Criteria for Anadromous Salmonids* (NMFS 1997, Appendix D). For projects in the Delta or in areas where Delta smelt may occur, the design approach velocity would be 0.2 feet per second and channel diversion would be coordinated with the USFWS because the Delta smelt is under the USFWS jurisdiction. FEMA or recipient (subapplicant) will submit fish screen designs along with the ESA/MSA Review Form for approval by NMFS.

AMM-30: Temporary Water Diversion and Dewatering

Construction activities conducted within wetted channels whenever ESA-listed fish are reasonably certain to be present will isolate work areas through dewatering, unless NMFS and FEMA agree during project review that the dewatering would result in greater impact than conducting in-water work.

In-water work and channel diversion of live flow during project construction would be conducted in a manner to reduce potential impacts to rearing and migrating fish. Dewatering would be used to create a dry work area and would be conducted in a manner that minimizes turbidity into nearby waters. Water diversion and dewatering would include the following measures:

a. Heavy equipment would avoid flowing water other than temporary crossing or diverting activities.

b. If listed fish may be present in the areas to be dewatered, a NMFS-approved fish rescue would be conducted by a qualified Fisheries Biologist in accordance with AMM-17: Fish Relocation.

c. Suspended sediment in water pumped or removed from dewatered areas would be filtered or allowed to settle before its release, or allowed to filter through vegetated upland areas prior to re-entering the stream channel so that it does not contribute turbidity to nearby waters.

d. Where gravity feed is not possible, a pump may be used to sustain stream flow. Pump intakes in any fish bearing waters would be appropriately screened to avoid fish entrainment as described in AMM-30.

e. Temporary culverts to convey live flow during construction activities would be placed at stream grade and be adequately sized to not increase stream velocity.

f. Silt fences or mechanisms to avoid sediment input to the flowing channel would be erected adjacent to flowing water if sediment input to the stream may occur.

g. When construction is complete, the construction site would be re-watered slowly to prevent loss of surface flow downstream, and to prevent a sudden increase in stream turbidity.

AMM-31: Pile Driving Methods

FEMA would ensure the following measures would be implemented by the recipient (subapplicant) to reduce the effects of underwater noise during pile driving when it is conducted in locations potentially supporting listed species:[8]

a. Piles may be concrete, or steel round pile 24 inches in diameter or smaller, steel H-pile designated as HP24 or smaller, or wood. If the wood has been treated, it must be sealed with an inert coating as described below:

   1. Pile wrappings may be used to wrap new inorganic arsenical treated wood piles (chromated copper arsenate and ammonia copper-zinc arsenate) in aquatic environments. Pile wraps cannot be used for new creosote, creosote solutions, or oil-borne preservatives under this biological opinion.

   2. Wraps can be pre-formed plastic such as polyvinyl chloride (PVC), fiber glass-reinforced plastic, or a high density polyethylene (HDPE) with an epoxy fill, petrolatum saturated tape (PST), or an inner wrap in the void between the wrapping and the pile.

[8] Any project activity that would harm or harass marine mammals also requires an Incidental Harassment Authorization from NMFS, independent of the PBA-PBO.

i. Exterior pilings, pilings that will come into direct contact with ocean and barge vessels, may only use high density polyethylene pile wrappings, steel-reinforced concrete, or steel-cased pilings.

ii. The material used for interior pilings must be durable enough to maintain the integrity for at least 10-years and a minimum of 1/10 of an inch thick with all joints sealed to prevent leakage.

iii. Sealing or capping the tops of the pilings shall prevent treated wood surface exposure within the water column and prevent dripping.

3. Pile wrappings will extend above and below the portion of the piling in contact with the water. The wrapping shall extend down into the substrate at least 18 inches below the mudline to contain treatment chemicals. The wrapping may extend to either the top of the piling or to a minimum height above the ordinary high water mark for riverine systems or the HAT line for marine systems to protect the treated wood from water contact.

4. All operations to prepare pile wrappings for placement cutting, drilling, and placement of epoxy fill will occur in a staging area away from the waterbody.

5. Polyurea barrier systems may be used to coat new inorganic arsenical pressure-treated wood piles in aquatic environments. The coating must be an impact-resistant, biologically inert coating that lasts or is maintained for a specified amount of time (NMFS 2009a).

   i. The polyurea coating should be specified by the manufacturer for in-water use to avoid degradation of the coating and over water spills. Prefabrication will be used whenever possible to minimize cutting, drilling and field preservative treatment.

   ii. Polyurea products must be coated on dry piles, free of loose wood, splinters, or sawdust and mechanical damage.

   iii. Only products treated in accordance with the WWPI and best management practices will be accepted for coating.

   iv. The polyurea coating must be ultraviolet light resistant and a minimum of 250 mil thick in the area that is submerged (Morrell 2017)

6. All pile wrappings and coatings will require an inspection and maintenance program. The program is designed to identify potential failures within the pile barrier system as soon as possible after a breach occurs. It is recommended that the maintenance of wrapped piles be performed by an experienced and licensed marine contractor. All submerged portions of the wrapped pilings will be inspected every 1-2 years beginning 3-5 years after installation, particularly in active facilities where there is the potential for abrasion or boat collisions that can damage the barrier.

7. When to Repair. Small gaps or tears in the barrier will have little effect on potential migration of preservative. Damage to 25 % or more of the barrier surface on an individual pile should result in action to repair the surface by adding additional coating or

barrier material to mitigate any future preservative loss. Missing or damaged wraps should be replaced as soon as possible.

b. Pre-project analysis of underwater noise would be conducted for all pile driving. Pile driving analysis would follow the criteria outlined in the California Department of Transportation's *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish* (Caltrans 2015) and would utilize the latest underwater noise criteria established by the Fisheries Hydroacoustic Working Group (FHWG 2008).

c. A vibratory driving hammer or other low-impact method would be used when feasible, because it produces lower sound energy in the water. Otherwise, refer to item b.

d. Construction projects that require the use of impact pile driving would require underwater noise monitoring and analysis during all phases of the pile driving to determine the intensity and extent of potential sound effects on listed species. Prior to the start of construction, an NMFS-approved sound monitoring plan would be developed. This plan would provide detail on the sound attenuation system and the methods used to monitor, verify, and report sound levels during pile driving activities. The sound monitoring results would be made available to NMFS.

e. When using an impact hammer to drive or proof a steel pile, one of the following sound attenuation methods would be used:

   1. Completely isolate the pile from flowing water by dewatering the area around the pile.

   2. If water velocity is 1.6 feet per second or less, surround the pile being driven by a confined or unconfined bubble curtain that would distribute small air bubbles around 100% of the pile perimeter for the full depth of the water column. See, *e.g.*, NMFS and USFWS (2006), Caltrans Technical Report No. CTHWANP-RT-306.01.01 (2015), Wursig *et al*. (2000), and Longmuir and Lively (2001).

   3. If water velocity is greater than 1.6 feet per second, surround the pile being driven with a confined bubble curtain (*e.g.*, surrounded by a fabric or non-metallic sleeve) that would distribute air bubbles around 100% of the pile perimeter for the full depth of the water column.

   4. Provide NMFS information regarding the timing of in-water work, the number of impact hammer strikes per pile and the estimated time required to drive piles, hours per day pile driving would occur, depth of water, and type of substrate, hydroacoustic assumptions, and the pile type, diameter, and spacing of the piles.

f. A "soft-start" technique would be used during pile extraction and driving to allow fish to vacate the area before the pile driver reaches full power. For vibratory hammers, the contractor would initiate the driving for 15 seconds at reduced energy followed by a 1-minute waiting period. This procedure would be repeated two additional times before continuous driving is started. For impact driving, an initial set of three strikes would be made by the hammer at 40% energy, followed by a 1-minute waiting period, then two subsequent three-strike sets before initiating continuous driving.

g. Piles would be pulled out in their entirety using a vibratory hammer, if feasible. If they break while being pulled or cannot be pulled out, they would be cut off at or below the mud or substrate level. Removed piles would be slowly lifted out of the sediment and water and placed in a containment basin made with durable plastic sheeting and sufficiently high walls to retain sediment and return flow.

1.3.10 Monitoring and Reporting Requirements

FEMA would be responsible for ensuring that all project monitoring and reporting required in the BO (e.g., revegetation monitoring, underwater noise monitoring, fish capture and relocation reporting) for the proposed project is completed by the recipient (subapplicant), along with any other monitoring or reporting as required by NMFS for the specific project. FEMA would be responsible for failures to complete such monitoring and reporting.

All project ESA/MSA Review Forms and reports are to be submitted electronically to NMFS at fema.programmaticbiop@noaa.gov. FEMA will send only **one** project per e-mail submittal, and will attach all related documents.

1.3.11 Annual Reporting Requirements

FEMA would prepare and submit an annual report to NMFS containing a summary of the numbers and types of projects implemented that were covered under the BO. This annual report would include a tabular summary of those projects. An accounting of take based on either a number of individuals or disturbance to suitable habitat as a surrogate would be provided in the annual report, which would include a tally of the total from all prior years. This summary also would include the project locations, recipient (subapplicant) names, and the federally listed species covered, among other project information.

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

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

2.1 Analytical Approach

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

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (50 CFR 402.02).

The designation(s) of critical habitat for species use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.

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

The proposed action for this consultation is a mixed programmatic action as defined by 50 CFR 402.02. A mixed programmatic action approves actions that are reasonably certain to cause take, and which will not be subject to further section 7 consultation, and also approves a framework for the development of future actions that are authorized, funded, or carried out at a later time. Take of a listed species would not occur unless and until those future actions are authorized, funded, or carried out and subject to further section 7 consultation. This proposed action includes construction activities that are reasonably certain to cause take, and therefore will not be the subject of future individual consultations. We provide an incidental take exemption, associated reasonable and prudent measures, and terms and conditions for take resulting from these activities in the incidental take statement in this document. The reminder of the activities included in the proposed action will be addressed by individual or programmatic consultations if those actions may affect listed species or critical habitat. To complete our jeopardy and adverse modification analysis, we analyze effects of these activities considering how the action agency's proposed management objectives and direction influence the nature of those effects. We then consider the action agency's projected level of activity to predict, to the degree we can, the scale of any impact on listed species and critical habitat. For the activities that will be the subject of future consultations, we do not try to predict exactly what will happen at a particular action site in the future. Rather, our jeopardy and adverse modification analysis focuses on whether the management objectives and direction set sideboards that achieve an adequate level of conservation for listed species and critical habitat. We reserve the ability to conclude that any future site-specific action that appreciably reduces the likelihood of both the survival and recovery of a listed species would jeopardize the continued existence of listed species. Likewise, we reserve the ability to conclude that any future site-specific action that appreciably diminishes the value of critical habitat for the conservation of a listed species would adversely modify critical habitat. Any take we determine will not jeopardize the continued existence of listed species resulting from activities that will be the subject of future consultations will be exempted in future incidental take statements.

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 risk that the listed species faces, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section 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.

Information and GIS layers is located at the NMFS Westcoast Fisheries Critical Habitat Webpage.

This BO covers 13 federally listed species (including their respective distinct population segments (DPSs) and evolutionarily significant units (ESUs)) under NMFS jurisdiction that have a high potential to occur within the Action Area, their critical habitat, and EFH in the Action Area. The federally listed species of fish potentially occurring in the action area under NMFS jurisdiction include:

North American green sturgeon (*Acipenser medirostris*, one DPS): Southern DPS.
Coho salmon (*Oncorhynchus kisutch*, two ESUs):
- Southern Oregon/Northern California Coast ESU, and
- Central California Coast ESU.

Steelhead (*Oncorhynchus mykiss*, five DPSs):
- Southern California DPS,
- South-Central California Coast DPS,
- Northern California DPS,
- Central Valley DPS, and
- Central California Coast DPS.

Chinook salmon (*Oncorhynchus tshawytscha*, three ESUs):
- California Coastal ESU,
- Central Valley Spring-run ESU, and
- Sacramento River Winter-run ESU.

Eulachon (*Thaleichthys pacificus*, one DPS): Southern DPS; and
Black abalone (*Haliotis cracherodii*).

The black abalone is the only federally listed invertebrate under NMFS jurisdiction with a high potential to occur in the Action Area. Table 2 provides the listing status and critical habitat designation for these listed species.

Table 2. Federally Listed ESU/DPS and Critical Habitat Covered under BO

Specie sand ESU/DPS	ESA Listing Status* (Federal Register Location)	ESA Critical Habitat* (Federal Register Location)
Green Sturgeon, Southern DPS	Threatened (71 FR 17757)	Oct 9, 2009 (74 FR 52300)
Coho Salmon, Southern Oregon/Northern California Coast ESU	Threatened (70 FR 37160)	May 5, 1999 (64 FR 24049)
Coho Salmon, Central California Coast ESU	Endangered (70 FR 37160)	May 5, 1999 (64 FR 24049)
Steelhead, Southern California DPS	Endangered (71 FR 834)	Sept 2, 2005 (70 FR 52488)
Steelhead, South-Central California Coast DPS	Threatened (71 FR 834)	Sept 2, 2005 (70 FR 52488)
Steelhead, Northern California DPS	Threatened (71 FR 834)	Sept 2, 2005 (70 FR 52488)
Steelhead, Central Valley DPS	Threatened (71 FR 834)	Sept 2, 2005 (70 FR 52488)
Steelhead, Central California Coast DPS	Threatened (71 FR 834)	Sept 2, 2005 (70 FR 52488)
Chinook Salmon, California Coastal ESU	Threatened (70 FR 37160)	Sept. 2, 2005 (70 FR 52488)
Chinook Salmon, Central Valley Spring-run ESU	Threatened (70 FR 37160)	Sept. 2, 2005 (70 FR 52488)
Chinook Salmon, Sacramento River Winter-run ESU	Endangered (70 FR 37160)	June 16, 1993 (58 FR 33212)
Euchalon, Southern DPS	Threatened (75 FR 13012)	Oct 20, 2011 (76 FR 65324)
Black Abalone	Endangered (74 FR 1937)	Oct. 27, 2011(76 FR 66806)

- DPS = Distinct Population Segment
- ESA = Endangered Species Act
- ESU = Evolutionary Significant Unit
- FR = Federal Register

* Date of final listing or designation, does not include subsequent updates or modifications posted to the FR.

2.2.1 Life History and Range

2.2.1.1 Coho Salmon

Coho salmon (*Oncorhynchus kisutch*) in North America presently range from Scott Creek, in California, to Point Hope, Kotzbue Sound Alaska (Sandercock 1991, Weitkamp *et al*. 1995). Coho salmon are distributed along the California coast from the Oregon border in the north to Monterey Bay in the south and are extirpated from the San Francisco/San Pablo Bay system, where they were historically present.

Coho salmon are semelparous salmonids, spending the first half of their life cycle rearing in streams and small freshwater tributaries. The remainder of the life cycle is spent foraging in estuarine and marine waters of the Pacific Ocean before returning to their stream of origin to spawn and die. Nearly all adult coho salmon returning to spawn in the coastal systems along the northern California coast system enter the estuary in December and January, spawn by mid-winter, and then die. Most spawning adults are three-years old; however, a small percentage (5–20 percent) of precocious males known as "jacks" return to spawn as two-year olds (Weitkamp *et al*. 1995). Eggs incubate in redds (gravel spawning nests) for 1-3 months, depending on the water temperature, before emerging as alevins (larval life stage that depends upon yolk sacs as its food source). Alevins emerge as fry from February to May and initially congregate in shaded backwaters, side channels, or small streams where the stream velocity is less.

Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although they may move up to streams of 4 or 5 percent gradient. Juveniles occupy 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 lower river and estuary habitat as age 0+ juveniles (Tschaplinski 1988, Koski 2009). Emigration of age 0+ coho salmon is not as common as emigration at age 1 or 2, but represents an important nomadic life history diversity strategy that adds resilience to populations(Koski 2009). 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). As small as 38 to 45 mm long, fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Sandercock 1991, Nickelson *et al*. 1992). Emigration from streams to the estuary and ocean generally takes place from March through May. Peak outmigration timing generally occurs in May, with some runs earlier or later, and with most smolts measuring 90-115 mm fork length.

As fry grow, they migrate to habitats with complex cover such as undercut banks, rootwads, large woody debris (LWD) and vegetative overhangs. Instream habitat complexity, including a mixture of pools and riffles, LWD, and well oxygenated cool water (10-15 degrees Celsius (°C)/50-59 degrees Fahrenheit (°F)) are important habitat components for coho salmon fry (Sandercock 1991, Moyle 2002b). The most productive coho salmon nursery habitats tend to be small streams having a larger ratio of slack water to midstream area (Sandercock 1991). Fry typically rear in freshwater for up to 15 months, migrating to the ocean in the spring as smolts. Coho salmon typically spend two growing seasons in the ocean before returning to their natal stream to spawn. In the estuary, smolts often linger for a period, moving up and down with tidal currents, suggesting that period of estuarine residence is preferred for adjusting their osmoregulatory system to seawater (Nielson 1994).

Survival and distribution of juvenile coho salmon have been associated with available winter habitat (Bustard and Narver 1975, Peterson 1982, Tschaplinski 1988, Nickelson *et al*. 1992, Quinn 1996). Both instream cover and off-channel habitats that provide slow water are essential to juvenile coho salmon for protection against displacement by high flows and as for cover from predation (Bustard and Narver 1975, Mason 1976, Solazzi *et al.* 2000). Juvenile coho appear to prefer deep (greater than 1.5 feet), slow water (less than 1 fps) habitats within or near cover of roots, large wood, or flooded brush (Bustard and Narver 1975), especially during freshets (Tschaplinski and Hartman 1983, Swales *et al.* 1986, and McMahon *et al.* 1989).

During the fall and spring, juvenile coho salmon often make seasonal or temporary shifts to off-channel areas that provide key winter habitat features when temperatures drop and base flows rise (Scarlett and Cederholm 1984, Bell *et al.* 2001). These off-channel habitats provide low velocity rearing areas, often with ample foraging opportunities (Bell *et al.* 2001). Overwintering coho salmon are often found in slower velocity habitats such as floodplains, sloughs, alcoves, backwaters, beaver ponds, and complex or deep in-channel habitats associated with large wood. Off-channel ponds are important winter rearing areas for juvenile coho salmon, and growth rates of juveniles in off-channel habitats were greater than those in the mainstem river segments (Morley *et al.* 2005, Swales and Levings 1989, Brown *et al*. 1988).

2.2.1.2 Chinook Salmon

Within oceanic waters, Chinook salmon range from the Gulf of Alaska and the Bearing Sea to Monterey Bay, with different ESUs frequenting different oceanic regions. Historically, Chinook salmon of California occurred in coastal drainages as far south as the Ventura River in Southern California and occupied the majority of the Sacramento and San Joaquin River watersheds up to natural impassable barriers, such as waterfalls (NMFS 2014a). The freshwater range of Chinook salmon has been greatly restricted by the placement of dams on waterways. The species is no longer present in coastal waterways south of the Russian River. Estuaries, such as San Francisco Bay and Humboldt Bay, provide rearing habitat for outmigrating juveniles (Moyle 2002b).

Healey (1991) describes two basic life history strategies (races) for Chinook salmon, stream-type and ocean-type, although there is variation within each life history strategy. Like most salmonids, Chinook salmon have evolved variation in juvenile and adult behavior 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 2002b). Several independent populations reproduce in California waterways, separated either geographically or by timing of migration and spawning. Fall-run Chinook salmon migrate upstream to spawning grounds from July through April and spawn October through February. Winter-run Chinook enter the rivers November to June and spawn primarily from mid-May to mid-August. Spring-run Chinook migrate upstream March to July and spawn late-August to early-October (Meyers *et al.* 1998). Juveniles emerge from the gravel and typically spend one year in freshwater before migrating downstream to estuaries and then the ocean (Moyle 2002b).

In California, ocean-type Chinook salmon tend to use estuaries and coastal areas for rearing more extensively than stream-type Chinook salmon (Thorpe 1994). Juveniles emerge from the gravel and generally within a matter of months, migrate downstream to the estuary and the ocean (Moyle 2002b, Quinn 2005). Fresh water residence, including outmigration, usually ranges from two to four months. After emergence, Chinook salmon fry seek out areas behind fallen trees, back eddies, undercut banks, and other areas of bank cover. As they grow larger, their habitat preferences change (Everest and Chapman 1972). 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 the risk of predation and reduce energy expenditure. 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 2002b).

After emergence from redd gravels in the spring, most individuals only rear in the reach for a few weeks to a few months prior to outmigration to the ocean in the late winter through early summer (Moyle 2002). These individuals likely utilize cool water seeps, thermally stratified deep pools, and cool tributaries to escape lethal temperatures as has been documented in juvenile steelhead (Nielsen *et al.* 1994).

2.2.1.3 Steelhead

The present distribution of steelhead extends from the Kamchatka Peninsula in Asia, east to Alaska, and south to southern California. In North America, steelhead is one of six Pacific salmon species that are native to the west coast. However, some steelhead populations have experienced declines in abundance during the past several decades due to various human-induced factors such as habitat loss, and water system development (e.g., storage, withdrawal, conveyance, and diversion for agriculture, flood control, domestic, and hydropower purposes). Steelhead life history patterns are complex, and there is no single factor solely responsible for this decline

Steelhead typically refers to the anadromous form of rainbow trout. Steelhead possess one of the most complex life history patterns of the Pacific salmonid species. Similar to other Pacific salmon, steelhead adults spawn in freshwater and spend a part of their life history at sea. However, unlike Chinook and coho salmon, steelhead exhibit a variety of life history strategies during their freshwater rearing period, and adults may spawn more than once during their life. The typical life history pattern for steelhead is to rear in freshwater streams for two years, followed by up to two or three years of residency in the marine environment. However, juvenile steelhead may rear in freshwater from one to four years (Moyle 2002a).

Steelhead spawn in gravel and small cobble substrates usually associated with riffle and run habitat types. Most young-of-the-year (YOY) fish prefer riffles, while larger (older) fish move into pools. Cover is extremely important in determining distribution; more cover leads to more fish (Meehan and Bjornn 1991). Preferred water temperatures are 13 to 21 °C (55 –70 °F). Most outmigration is during the spring (January to June), but some outmigration may occur during any significant runoff event.

There are two basic steelhead life history patterns, winter-run and summer-run (Quinn 2005, Moyle 2002b). Winter-run steelhead enter rivers and streams from December to March in a sexually mature state, migrate to spawning areas and often ascend long distances, and then spawn soon after in tributaries of mainstem rivers (McEwan and Jackson 1996, Moyle 2002b). Steelhead typically emerge from redd gravels in late spring and early summer, and rear in freshwater for 1–3 years. When water temperatures begin to exceed tolerated levels, juvenile steelhead may seek out cool water seeps and thermally stratified pools (Nielsen *et al.* 1994).

Summer steelhead, also known as spring-run steelhead, enter rivers in a sexually immature state during receding flows in the spring and migrate to headwater reaches of tributary streams where they hold in deep pools until spawning the following winter or spring (Moyle 2002b). 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 2002b). 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. Steelhead smolts are usually 15-20 cm total length and migrate to the ocean in the spring (Meehan and Bjornn 1991). 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 2002b). 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. However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Busby *et al.* 1996). Some steelhead "residualize," becoming resident trout and never adopting the anadromous life history.

Upon emerging from the gravel, steelhead fry rear in edgewater habitats and move gradually into pools and riffles as they grow larger; older juveniles establish and defend territories (NMFS 2011a). Cover is an important habitat component for juvenile steelhead, both as velocity refuge and as a means of avoiding predation (Shirvell 1990, Meehan and Bjornn 1991). Summer rearing steelhead tend to use riffles and other habitats not strongly associated with cover more than other salmonids (NMFS 2011a), but winter rearing juvenile steelhead become inactive and hide in any available cover, including large substrate or woody debris (NMFS 2011a).

2.2.1.4 Eulachon

Eulachon are an anadromous fish that are endemic to the northeastern Pacific Ocean. They range from northern California to southwest and south-central Alaska and into the southeastern Bering Sea. The Southern DPS Eulachon spawns in creeks from the US-Canada border down to the Mad River in California. The distribution of the Southern DPS includes the Rogue River and Umpqua Rivers in Oregon, the Columbia River, and some coastal rivers and tributaries to Puget Sound, Washington. Adult eulachon have been recorded at several locations on the Washington and Oregon coasts, and they were previously common in Oregon's Umpqua River and the Klamath River in northern California. Runs occasionally occur in many other rivers and streams, although these tend to be erratic, appearing in some years but not others, and appearing only rarely in some river systems (Hay and McCarter 2000, Willson 2006, NMFS 2010b). In California, they have been documented between Crescent City and Eureka in the Klamath River, Redwood Creek, and Mad River (76 FR 65324).

Eulachon are planktivores that spend the majority of their life in nearshore ocean waters, up to 300 meters in depth. Eulachon typically spend 3 to 5 years in saltwater before returning to freshwater to spawn from late winter through mid-spring. During spawning, males have a distinctly raised ridge along the middle of their bodies. Spawning grounds are typically in the lower reaches of larger snowmelt-fed rivers, with water temperatures ranging from 39 to 50°F

(4 to 10°C). Eggs are fertilized in the water column, and then sink and adhere to the river bottom, typically in areas of gravel and coarse sand. Most eulachon adults die after spawning. Eulachon eggs hatch in 20 to 40 days. The larvae are carried downstream, and are dispersed by estuarine and ocean currents shortly after hatching. Juvenile eulachon move from shallow nearshore areas to mid-depth areas as they grow larger (NMFS 2014c).

2.2.1.5 Green Sturgeon

The green sturgeon is 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). Two distinct population segments (DPSs) of North American green sturgeon have been identified; a northern DPS (nDPS) and a southern DPS (sDPS). While individuals from the two DPS's are visually indistinguishable and have significant geographical overlap, current information indicates that they do not interbreed or utilize the same natal streams. The Southern DPS green sturgeon contains a single spawning population in the Sacramento River (NMFS 2005c, NOAA-SWFSC 2005, NMFS 2014d).

Green sturgeon belong to the family Acipenseridae, an ancient lineage of fish with a fossil record dating back approximately 200 million years. They are known to be long lived; green sturgeon captured in Oregon have been aged up to 52 years old, using a fin-spine analysis (Farr *et al.* 2005). Green sturgeon are highly adapted to benthic environments, spending the majority of their lifespan residing in bays, estuaries, and near coastal marine environments. They are anadromous, migrating into freshwater riverine habitats to spawn; and iteroparous as individuals are able to spawn multiple times throughout their lifespan.

Green sturgeon reach sexual maturity between 15–17 years of age (Beamesderfer *et al.* 2007). Green sturgeon fecundity is approximately 50,000–80,000 eggs per adult female (Van Eenennaam *et al.* 2001), and they have the largest egg size of any sturgeon. The outside of the eggs are mildly adhesive, and are denser than those of white sturgeon (Kynard *et al.* 2005, Van Eenennaam *et al.* 2008). Further details of their life history can be found in various literature sources such as (Moyle 2002b, Adams *et al.* 2007, Beamesderfer *et al.* 2007, Israel and Klimley 2008).

2.2.1.6 Black Abalone

Black abalone are marine snails with a univalve shell, typically 5 to 9 open respiratory pores, an anterior head, and a large muscular foot (Cox 1960). Black abalone occupy rocky intertidal habitats from the upper intertidal to 6 meters depth. Historically, black abalone occurred from Crescent City (Del Norte County, California) to southern Baja California (Geiger 2004), but the current range is from Point Arena, California, to Bahia Tortugas, Mexico, including offshore islands (74 FR 1937). Black abalone are most commonly observed in the middle and lower intertidal, in habitats with complex surfaces and deep crevices that provide shelter for juvenile recruitment and adult survival (Leighton 1959, Cox 1960, Leighton 1963, Douros 1985, Douros 1987, VanBlaricom *et al.* 1993, Haaker *et al.* 1995, Leighton 2005). They are able to withstand extreme variations in temperature, salinity, moisture, and wave action, and are usually strongly aggregated, with some individuals stacking two or three on top of each other (Cox 1960, Leighton 2005). Genetic studies indicate limited larval dispersal, with populations composed predominately of individuals spawned locally (Hamm and Burton 2000, Chambers *et al*. 2006, Gruenthal and Burton 2008). Genetic differentiation exists between island populations and mainland populations (Chambers *et al*. 2006).

As broadcast spawners, black abalone must be in close enough proximity to one another to successfully reproduce. They also have a short planktonic larval stage (about 3-10 days) before settlement and metamorphosis (McShane 1992). Larval black abalone are believed to settle on rocky substrate with crustose coralline algae, which serves as a food source for post-metamorphic juveniles, along with microbial and diatom films (Leighton 1959, Leighton 1963, Bergen 1971). Reproductive maturity is reached at a size of about 50 mm shell length in females and about 40 mm in males (Leighton 1959, Ault 1985). Spawning has not been observed in the wild, but likely occurs from spring to early autumn (Leighton 1959, Leighton 1963, Webber and Giese 1969, Leighton 2005).

2.2.2 Status of the Species

2.2.2.1 Southern California

2.2.2.1.1 Southern California Steelhead DPS Status

The geographic range of this DPS extends from the Santa Maria River, near Santa Maria, to the California–Mexico border (NMFS 1997b) and (NMFS 2016f) which represents the known southern geographic extent of the anadromous form of *O. mykiss*.

The abundance of wild steelhead in California has decreased significantly from historic levels (Moyle 2002b). Historically, 46 SC steelhead populations existed (Boughton et al 2007), although over half of the populations have been extirpated (Boughton et al. 2005).This decline prompted listing of the southern California population of steelhead as endangered on August 18, 1997 (62 FR 43937), which includes all naturally spawned populations of steelhead and their progeny originating below long-standing impassable barriers. The endangered status was reaffirmed on January 5, 2006 (71 FR 834). Estimates of historical (pre-1960s) and recent (1990s - current) abundance of steelhead show a precipitous drop in numbers of spawning adults for major rivers within the range of the Southern California Coast (SC) DPS of steelhead. Recent updated status reports indicate that chief causes for the numerical decline of steelhead in southern California include urbanization, water withdrawals, channelization of creeks, human-made barriers to migration, and the introduction of exotic fishes and riparian plants (Good *et al.* 2005b, Williams *et al*. 2011a, NMFS 2016f).

NMFS described historical and recent steelhead abundance and distribution for the southern California coast through a population characterization (Boughton and Goslin 2006). Surveys in Helmbrecht and Boughton (2005) indicate between 58 percent and 65 percent of the historical steelhead basins currently harbor *O. mykiss* populations at sites with connectivity to the ocean. Most of the apparent losses of steelhead were noted in the south, including Orange and San Diego counties (Helmbrecht and Boughton 2005). The majority of losses (68 percent) of steelhead were associated with anthropogenic barriers to steelhead migration (e.g., dams, flood-control structures, culverts, etc.). Additionally, authors found the barrier exclusions were statistically associated with highly-developed watersheds. Only 10 population units possess a high and biologically plausible likelihood of being viable and independent (Boughton and Goslin 2006).

Critical Habitat and Physical or Biological Features for Southern California Steelhead

Critical habitat for the SC DPS was designated on September 2, 2005 (70 FR 52488). Critical habitat for the SC DPS encompasses 708 miles of stream habitat within a small part of San Luis Obispo County, Santa Barbara, Ventura, Los Angeles, Orange, and San Diego counties from the Santa Maria River HU south to the San Juan HU.

We summarize here relevant information from the final rule regarding the PBFs and activities with the potential to affect critical habitat; the final rule provides more detail. The designation identifies PBFs that include sites necessary to support one or more steelhead life stages and, in turn, these sites contain the physical or biological features essential for conservation of the DPS. Specific sites include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine areas. The physical or biological features that characterize these sites include water quality, quantity, depth, and velocity, shelter/cover, living space, and passage conditions.

Habitat for steelhead has suffered destruction and modification, and anthropogenic activities have reduced the amount of habitat available to steelhead (Nehlsen *et al* 1991, NMFS 1997b, Boughton and Goslin 2006, 71 FR 834). In many watersheds throughout the range of the SC DPS, the damming of streams has precluded steelhead from hundreds of miles of historical spawning and rearing habitats (e.g., Twitchell Reservoir within the Santa Maria River watershed, Bradbury Dam within the Santa Ynez River watershed, Matilija Dam within the Ventura River watershed, Rindge Dam within the Malibu Creek watershed, Pyramid Dam and Santa Felicia Dam on Piru Creek).

These dams created physical barriers and hydrological impediments for adult and juvenile steelhead migrating to and from spawning and rearing habitats. Likewise, construction and ongoing impassable presence of highway projects have rendered habitats inaccessible to adult steelhead (Boughton and Goslin 2006). Within stream reaches that are accessible to this species (but that may currently contain no fish), urbanization (including effects due to water exploitation) have in many watersheds eliminated or dramatically reduced the quality and amount of living space for juvenile steelhead. The number of streams that historically supported steelhead has been dramatically reduced (Good *et al.* 2005b). Groundwater pumping and diversion of surface water contribute to the loss of habitat for steelhead, particularly during the dry season (e.g., NMFS (2005a), see also Spina (2006)). The extensive loss and degradation of habitat is one of the leading causes for the decline of steelhead abundance in southern California and listing of the species as endangered (71 FR 834 , NMFS 1997b).

A significant amount of estuarine habitat has been lost across the range of the DPS with an average of only 22-percent of the original estuarine habitat remaining (Williams *et al*. 2011a). The condition of these remaining wetland habitats is largely degraded, with many wetland areas at continued risk of loss or further degradation. Although many historically harmful practices have been halted, much of the historical damage remains to be addressed and the necessary restoration activities will likely require decades. Many of these threats are associated with the larger river systems such as the Santa Maria, Santa Ynez, Ventura, Santa Clara, Los Angeles, San Gabriel, Santa Ana, San Luis Rey, Santa Margarita, San Dieguito, and San Diego rivers, but they also apply to smaller coastal systems such as Malibu, San Juan, and San Mateo creeks. Overall, these threats have remained essentially unchanged for the DPS as determined by the last status review (Williams *et al*. 2016) though some individual, site specific threats have been reduced or eliminated as a result of conservation actions such as the removal of small fish passage barriers.

2.2.2.1.2 South-Central California Coast Steelhead Status

The South-Central California Coast (SCCC) DPS of steelhead as threatened on 18 August 1997 (62 FR 43937) and was reaffirmed on January 5, 2006 (71 FR 834).

Boughton et al (2006) identified 41 historically independent populations of SCCC steelhead in the DPS. This DPS occupies rivers from the Pajaro River, Santa Cruz County, south to but not including the Santa Maria River, in Santa Barbara County. The 41 populations are divided into four biogeographical regions including (from north to south): Interior coast range, Carmel Basin, Big Sur Coast, and San Luis Obispo Terrace (Boughton et al. 2007).

The status of the SCCC steelhead populations was assessed by NMFS' Biological Review Team (BRT) in 1996 (Busby *et al.* 1996), 2005 (Good *et al.* 2005b), 2011 (Williams *et al.* 2011a), and 2016 (Williams *et al*. 2016). Abundance of adult steelhead in the SCCC DPS declined from a historical high abundance of 25,000 returning adults, to an estimate of 4,750 adults in 1965 for five river systems (Pajaro, Salinas, Carmel, Little Sur, and Big Sur), to fewer than 500 adults currently (Boughton and Fish 2003, Good *et al.* 2005b, Helmbrecht and Boughton 2005, Williams *et al.* 2011a).

As part of the assessment and listing of SCCC steelhead, the BRT evaluated the viability[9] (discussed in greater detail below) and extinction risk of naturally spawning populations within each DPS. The BRT found high risks to abundance, productivity, and the diversity of the SCCC DPS and expressed particular concern for the DPS's connectivity and spatial structure. NMFS' latest 5-year status review for the South-Central California Coast DPS of steelhead states the following:

> "The extended drought and drying conditions associated with projected climate change has the potential to cause local extinction of *O. mykiss* populations and thus reduce the genetic diversity of fish within the South-Central California Coast Steelhead Recovery Planning Area." (page 55, Williams *et al*. 2016).

Moreover, NMFS' recent assessment of viability for steelhead provides an indication that the South Central California Coast Steelhead DPS may be currently experiencing an increased extinction risk (Williams *et al*. 2016).

[9] Viable populations have a high probability of long-term persistence (> 100 years).

Population Viability

Before NMFS can evaluate the effects of the proposed action on a population and a species, an understanding of the condition of the population and species in terms of their chances of survival and recovery is critical for the effects analysis. The chances of survival and recovery contribute to NMFS' understanding of whether the population is likely to experience viability. Population viability is the hypothetical state(s) in which extinction risk of the broad population is negligible over a 100-year period and full evolutionary potential is retained (Boughton and Goslin 2006).

Four principal parameters are used to evaluate the extinction risk for endangered and threatened species of salmonids: abundance, population growth rate, population spatial structure, and population diversity. These specific parameters are important to consider because they are predictors of extinction risk, and the parameters reflect general biological and ecological processes that are critical to the growth and survival of steelhead (McElhany *et al.* 2000).

There are three basic concepts (adapted from Boughton and Goslin (2006)) that describe the meaning of population viability and how population growth rate and related parameters work together to provide a framework for judging the persistence of a population in the wild. The first concept is that for a population to persist indefinitely, on average each adult fish in the population has to give rise to at least one adult fish in the next generation (i.e., the population of adults must replace itself year after year). The second concept involves the size of the population. The larger the population, the less likely the population is to become extinct and the less likely that all mates will fail to produce eggs. Large population size is the single most important trait to protect a population from being driven to extinction due to random events. The third concept involves the relationship of vital events (e.g., births, deaths, and matings). The more correlated that vital events tend to be across the population, the larger the population has to be to protect it from extinction.

These concepts are expected to apply to the endangered SC DPS and threatened SCCC DPS of steelhead. The largest populations within these two DPSs are needed to support an effective recovery strategy. The role of the largest populations in recovery is based on population theory, which suggests the largest populations would have the highest viability if restored to an unimpaired condition (Boughton and Goslin 2006). In nature, population abundance fluctuates for a variety of reasons including random changes in environmental conditions (often referred to as environmental stochasticity). If the fluctuations are large enough, the number of individuals in the population can fall to zero, even though the population may be relatively large initially. The influence of environmental stochasticity on both DPSs is expected to be high, and because environmental stochasticity increases extinction risk to the population, and to compensate for the environmental influences, both the SC DPS and the SCCC DPS need to have a larger average size than a broad population that is not as affected by chance fluctuations in environmental conditions (Boughton and Goslin 2006).

The expected sources of environmental stochasticity in both DPSs involve drought (and associated features such as high temperatures, low streamflow, lack of sandbar breaching at the mouths of rivers), floods, and wildfire. Southern California experienced a 5-year drought where extensive instream drying was observed in numerous coastal drainages in the range of the SC DPS of steelhead. These drought conditions prompted NMFS and CDFW to collaborate on a high number of steelhead relocations in an attempt to enhance survival of fish in the wild. Under such conditions stream temperature can increase dramatically, exceeding the heat tolerance of fish, and dissolved- oxygen concentration can fall below levels tolerable for steelhead. Finding dead or dying juvenile steelhead is not uncommon under such conditions. In July 2007, the "Zaca" wildland fire was reported and burned over 240,000 acres within and near Santa Barbara County, including steelhead- bearing drainages (Janicki *et al.* 2007).

Based on the complete population viability evaluation and findings in Boughton *et al.* (2006), neither DPS is viable and both are at high risk of extinction. That is, each DPS has a low likelihood of viability (Boughton and Goslin 2006). This finding is consistent with conclusions of past and recent technical reviews (Busby *et al.* 1996, Good *et al.* 2005b, Williams *et al*. 2011a, Williams *et al.* 2016), and the formal listing determinations for the species (62 FR 43937, 71 FR 834).

Spatial structure of a steelhead population is also critical to consider during the jeopardy analysis when evaluating population viability. Each population's spatial structure comprises both the geographic distribution of individuals in the population and the processes that generate that distribution (McElhany *et al.* 2000). 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. Populations that are thinly distributed over space are susceptible to experiencing poor population growth rate and loss of genetic diversity (Boughton *et al.* 2007). Because human activities have decreased the total area of habitat, a negative trend on population viability is expected (McElhany *et al.* 2000). Construction and the ongoing impassable presence of man-made structures throughout the Southern California DPS have rendered many habitats inaccessible to adult steelhead (Helmbrecht and Boughton 2005). In many watersheds that are accessible to these species (but that may currently contain few or no fish), urbanization and exploitation of water resources has eliminated or dramatically reduced the quality and amount of living space for steelhead.

Population diversity is an additional factor considered within the viability criteria. Steelhead possess a suite of life-history traits, such as anadromy, timing of spawning, emigration, and immigration, fecundity, age-at-maturity, behavior, physiological and genetic characteristics, to mention a few. The more diverse these traits (or the more these traits are not restricted), the more likely the species is to survive a spatially and temporally fluctuating environment. Factors that constrain the full expression of a trait are expected to affect the diversity of a species (McElhany *et al.* 2000). The loss or reduction in anadromy and migration of juvenile steelhead to the estuary or ocean is expected to reduce gene flow, which strongly influences population diversity (McElhany *et al.* 2000). Evidence indicates genetic diversity in populations of southern California steelhead is low (Girman and Garza 2006).

Habitat is the "templet" for ecological variation in a species (Southwood 1977) and, accordingly, when a species' habitat is altered, the potential for the habitat to promote ecological variation is also altered. Loss or limited migration opportunities are expected to adversely affect the species' basic demographics and evolutionary processes, causing a reduced potential for both DPS units (SCCC and SC) to withstand environmental fluctuations. Activities that affect evolutionary processes (e.g., natural selection) have the potential to alter the diversity of the species. Hence, the widespread effects of anthropogenic activities in southern California are believed to have contributed to a decline in genetic diversity of southern California steelhead (Girman and Garza 2006).

Critical Habitat and Physical or Biological Features for South-Central California Coast Steelhead

Critical habitat for the SCCC DPS was designated on September 2, 2005 (70 FR 52488).

Designated critical habitat for the SCCC DPS includes 1,249-miles of stream habitat and 3-square miles of estuary habitat within Monterey, San Benito, Santa Clara, Santa Cruz, and San Luis Obispo counties from the Pajaro River Hydrologic Sub-area south to the Estero Bay Hydrologic Unit (HU) (to but not including the Santa Maria River HU) including those streams listed above in the Status of the Species section. There are 30 occupied hydrologic sub-unit watersheds within the freshwater and estuarine range of the DPS.

Critical habitat has a lateral extent as defined by the bankfull discharge, also known as a 2-year flood event. Estuarine areas of listed streams are also included in the designation, but the riparian zone is not included in the designation. PBFs within these streams essential for the conservation of the DPS are those sites and habitat components that support one or more steelhead life stages. These include freshwater spawning sites and rearing sites with water quantity and quality sufficient to form and maintain physical habitat conditions that support juvenile growth and mobility. PBFs include natural cover such as shade, submerged and overhanging large wood, logjams, beaver dams, aquatic vegetation, large rocks, boulders, side channels and undercut banks (70 FR 52488). Additional PBFs of critical habitat consist of freshwater migration corridors free of obstruction and excessive predation that have sufficient water quantity and quality, and physical cover within migration corridors that supports steelhead mobility and survival, as well as estuarine areas that also share these attributes. Also listed as PBFs are juvenile and adult steelhead food forage, including aquatic invertebrates and fishes that support steelhead growth and maturation (70 FR 52488).

Streams designated as critical habitat in the SCCC DPS have the above PBF attributes to varying degrees, depending on the stream location and the impacts associated with the watershed. NMFS' most recent status review for SCCC steelhead (Williams *et al.* 2016) identified habitat destruction and degradation as serious ongoing risk factors for this DPS. Urban development, flood control, water development, and other anthropogenic factors have adversely affected the proper functioning and condition of some spawning, rearing, and migratory habitats in streams designated as critical habitat. Urbanization has resulted in some permanent impacts to steelhead critical habitat due to stream channelization, increased bank erosion, riparian damage, migration barriers, and pollution (Williams *et al.* 2016). Many streams within the DPS have dams and reservoirs that reduce the magnitude and duration of flushing stream flows, withhold or reduce water levels suitable for fish passage and rearing, physically block upstream fish passage, and retain valuable coarse sediments for spawning and rearing. In addition, some stream reaches within the DPS' designated critical habitat may be vulnerable to further perturbation resulting from poor land use and management decisions.

Recovery Plans

The recovery plans for SCCC steelhead (NMFS 2013) and SC steelhead (NMFS 2012b) provide additional information on these and other threats and related recovery actions necessary to recover both species within individual watersheds and each DPS as a whole. Both recovery plans highlight a number of high priority DPS-wide recovery actions, including: physically modify passage barriers such as dams and diversion facilities to allow natural rates of migration to upstream spawning and rearing habitats; enhance protection of natural in-channel and riparian habitats, including appropriate management of flood-control activities, off-road vehicle use, and in-river sand and gravel mining practices; reduce water pollutants such as fine sediments, pesticides, herbicides, and other non-point source waste discharges; assess the condition of and restore estuarine habitats through the control of fill, waste discharges, and establishment of buffers; control artificial breaching and/or draining of coastal estuaries; and conduct research on the relationship between resident and anadromous forms of *O. mykiss*, and the population dynamics regarding distribution, abundance, residualization, dispersal, and recolonization rates.

2.2.2.1.3 Black Abalone Status

Black Abalone (*Haliotis cracherodii)* was listed as endangered on February 13, 2009 (74 FR 1937).

Black abalone are believed to be naturally rare at the northern and southern extremes of their range, (Morris *et al.* 1980, VanBlaricom *et al*. 2009). The highest abundances occurred south of Monterey, particularly at the Channel Islands off southern California (Cox 1960, Karpov *et al*. 2000). Rogers-Bennett *et al*. (2002) estimated a baseline abundance of 3.54 million black abalone in California, based on landings data from the peak of the commercial and recreational fisheries (1972-1981). This estimate provides a historical perspective on patterns in abundance and a baseline against which to compare modern day trends. We note, however, that black abalone abundances in the 1970s to early 1980s had reached extraordinarily high levels, particularly at the Channel Islands, possibly in response to the elimination of subsistence harvests by indigenous peoples and large reductions in the sea otter population. Thus, our understanding of black abalone abundance and distribution for this time period may not accurately represent conditions prior to commercial and recreational harvest of black abalone in California.

Beginning in the mid-1980s, black abalone populations began to decline dramatically due to the spread of withering syndrome (Tissot 1995), a disease caused by a Rickettsiales-like organism (WS-RLO) that affects the animal's digestion and causes starvation leading to foot muscle atrophy, lethargy, and death (Friedman and Finley 2003, Friedman *et al.* 2003, Braid *et al.* 2005). Withering syndrome results in rapid (within a few weeks) and massive (reductions of over 80%) mortalities in affected populations (Neuman *et al.* 2010). The first recorded mass mortality associated with the disease was observed at Santa Cruz Island in 1985 (Lafferty and Kuris 1993). Researchers have since recorded mass mortalities at sites throughout the Channel Islands and along the California mainland as far north as Cayucos (San Luis Obispo County) by 1998-1999 (Altstatt *et al*. 1996, Raimondi *et al.* 2002). Withering syndrome was also observed in central Baja California around Bahia Tortugas during El Niño events in the late 1980's and 1990s

(Altstatt *et al*. 1996), (Pedro Sierra-Rodriquiz, pers. comm., cited in (VanBlaricom *et al*. 2009)), and may be linked to declines in the abalone fishery there in the 1990s.

Overall, populations throughout southern California and as far north as Cayucos have declined in abundance by more than 80%; populations south of Point Conception have declined by more than 90% (Neuman *et al.* 2010). Due to the drastic decline in abundance, the black abalone was declared as endangered under the ESA on January 14, 2009 (74 FR 1937). Historical abalone harvest contributed to the decline to some degree, but the primary cause of these declines has been withering syndrome. The disease has also affected populations in Baja California, but little is known about the species' status in Mexico.

Populations north of Cayucos have not yet exhibited signs of the disease, but all are likely infected by the WS-RLO pathogen. Abalone may be exposed to and infected by the WS-RLO without showing symptoms, but once symptoms develop, the animals succumb to death rapidly (Friedman *et al*. 1997, Friedman *et al*. 2000, Friedman *et al.* 2002). The pathogen has been detected in all coastal marine waters of central (Friedman and Finley 2003) and southern California (Moore *et al.* 2002) up to south Sonoma County (Moore 2015), and has also been found at Southeast Farallon Island (pers. comm. with Jim Moore, CDFW/BML, cited in VanBlaricom *et al*. 2009). Disease transmission and manifestation is intensified when local sea surface temperatures increase by as little as 2.5 ºC above ambient levels and remain elevated over a prolonged period of time (i.e., a few months or more) (Friedman *et al*. 1997, Raimondi *et al.* 2002, Harley and Rogers-Bennett 2004, Vilchis *et al.* 2005). Thus, the northward progression of the disease appears to be associated with increasing coastal warming and El Niño events (Tissot 1995, Altstatt *et al*. 1996, Raimondi *et al.* 2002), and poses a continuing threat to the remaining healthy populations.

Most black abalone populations affected by withering syndrome remain at low densities, below the estimated levels needed to support successful reproduction and recruitment (0.34 abalone per m^2) (Neuman *et al.* 2010). Data for 2002-2006 indicate that population densities exceed this threshold value in areas not yet affected by the disease (north of Cayucos; densities range from 1.1 to 10.5 abalone per m^2), whereas population densities fall below this threshold value, many significantly so, in areas affected by the disease (south of Cayucos; densities range from 0 to 0.5 abalone per m^2) (Neuman *et al.* 2010). Despite these low densities, however, researchers have observed evidence of recent recruitment and increases in abundance at several locations throughout southern California, including the Palos Verdes Peninsula, Laguna Beach, Santa Cruz Island, San Miguel Island, and San Nicolas Island (Richards and Whitaker 2012, Eckdahl 2015, VanBlaricom 2015). These observations for black abalone, and similar observations for other abalone species in California, indicate that factors other than the number of abalone per square meter need to be considered when assessing population viability. In addition, recent studies indicate the potential for disease resistance to develop in wild black abalone populations. A bacteriophage has been discovered that infects the WS-RLO, reduces its pathogenicity, and improves the survival of infected abalone (Friedman and Crosson 2012, Crosson 2014, Friedman *et al.* 2014). Genetic-based disease resistance may also exist and is the subject of ongoing studies at the University of Washington (VanBlaricom *et al*. 2009).

Overall Risk of Extinction and Recovery Potential

Black abalone populations throughout California face high risk in each of four demographic risk criteria: abundance, growth rate and productivity, spatial structure and connectivity, and diversity (VanBlaricom *et al*. 2009). Although we know withering syndrome has affected populations in Baja California, little information exists regarding the species' status in that portion of the range. Long-term monitoring data in California indicates that disease-impacted populations remain at low abundance and density, and the disease continues to progress northward along the coast with warming events, threatening the remaining healthy populations (Raimondi *et al.* 2002). The declines in abundance have potentially resulted in a loss of genetic diversity, though this needs to be evaluated. Although some sites in southern California have shown evidence of recruitment, natural recovery of severely-reduced abalone populations will likely be a slow process. Recovering the species will involve protecting the remaining healthy populations to the north that have not yet been affected by the disease, and increasing the abundance and density of populations that have already been affected by the disease.

Critical Habitat and Physical or Biological Features for Black Abalone

NMFS designated critical habitat for black abalone on October 27, 2011 (76 FR 66806). The designation encompasses rocky intertidal and subtidal habitat (from the mean higher high water, MHHW, line to a depth of -6m relative to the mean lower low water, MLLW, line) within five segments of the California coast between Del Mar Landing Ecological Reserve to the Palos Verdes Peninsula, as well as on the Farallon Islands, Año Nuevo Island, San Miguel Island, Santa Rosa Island, Santa Cruz Island, Anacapa Island, Santa Barbara Island, and Santa Catalina Island. PBFs include: (1) rocky substrate (e.g., rocky benches formed from consolidated rock or large boulders that provide complex crevice habitat); (2) food resources (e.g., macroalgae); (3) juvenile settlement habitat (rocky substrates with crustose coralline algae and crevices or cryptic biogenic structures); (4) suitable water quality (e.g., temperature, salinity, pH) for normal survival, settlement, growth, and behavior; and (5) suitable nearshore circulation patterns to support successful fertilization and larval settlement within appropriate habitat.

Critical habitat areas within the non-disease impacted region (north of Cayucos) were generally identified as areas of high conservation value, because they serve as a refuge from withering syndrome, support stable populations, and contain habitat of good to excellent quality for black abalone. Within the disease-impacted region (south of Cayucos), changes to critical habitat features have occurred following the decline in black abalone. For example, at sites once dominated by black abalone, the decline in black abalone numbers has resulted in a shift in the invertebrate and algal community where increased growth of encrusting species like sponges may reduce the surface area for crustose coralline algae to grow, thereby reducing the quality of larval settlement habitat (Toonen and Pawlik 1994, Miner *et al*. 2006, VanBlaricom *et al*. 2009, 76 FR 66806). However, in general, these critical habitat areas continue to provide a high conservation value to the species, because they contain habitat of good to excellent quality that is able to support black abalone, with evidence of recruitment observed at a few sites (e.g., on San Nicolas Island and Santa Cruz Island) (VanBlaricom *et al*. 2009).

Threats to black abalone critical habitat include coastal development or in-water construction projects (e.g., coastal armoring, pier construction or repair); activities that can increase sedimentation (e.g., sand replenishment, beach nourishment, side-casting); oil or chemical spills and response activities; and vessel grounding and response activities. Operations that involve withdrawing water from and/or discharging water to marine coastal waters may also affect black abalone critical habitat by increasing local water temperatures (e.g., discharge of heated effluent), introducing elevated levels of metals or other contaminants into the water, or altering nearshore circulation patterns.

2.2.2.2 Central California Coast

2.2.2.2.1 Central California Coast Steelhead DPS Status

The CCC steelhead DPS includes all naturally spawned anadromous populations originating below natural and manmade impassable barriers in California streams from the Russian River (inclusive) to Aptos Creek (inclusive), and the drainages of San Francisco, San Pablo, and Suisun bays, eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers.

Historically, approximately 70 populations of steelhead existed in the CCC steelhead DPS (Spence *et al*. 2012, Spence *et al*. 2008). Many of these populations (about 37) were independent, or potentially independent, meaning they had a high likelihood of surviving for 100 years absent anthropogenic impacts (Bjorkstedt *et al.* 2005). The remaining populations were dependent upon immigration from nearby CCC steelhead DPS populations to ensure their viability (McElhany *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). By the late 90s, that number had dropped to approximately 4,000 fish (NMFS 1997b). Abundance estimates for smaller coastal streams in the DPS indicate low but stable levels with recent estimates for several streams (Lagunitas, Waddell, Scott, San Vicente, Pudding, Caspar creeks) of individual run sizes of 500 fish or less (62 FR 43937). Some loss of genetic diversity has been documented and attributed to previous among-basin transfers of stock and local hatchery production in interior populations in the Russian River (Bjorkstedt *et al.* 2005), and the ratio of hatchery fish to natural origin fish returning to spawn continues to be a source of concern (William *et al.* 2016). In San Francisco Bay streams, reduced population sizes and fragmentation of habitat has likely also led to loss of genetic diversity in these populations. For more detailed information on trends in CCC steelhead abundance, see: (Busby *et al.* 1996, NMFS 1997b, Good *et al.* 2005a, Spence *et al*. 2008, Williams *et al*. 2011a, Williams *et al.* 2016).

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. The 2005 status review concluded that steelhead in the CCC steelhead DPS remain "likely to become endangered in the foreseeable future" (Good *et al.* 2005b). 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 (Spence *et al*. 2008). The most recent status update concludes that steelhead in the CCC steelhead DPS remains "likely to become endangered in the foreseeable future" (NMFS 2016i), as new and additional information available since Williams *et al*. (2011a) does not appear to suggest a change in extinction risk.

The Multispecies Recovery Plan (NMFS 2015) for the CCC steelhead identifies multiple recovery actions, including: increasing quality and extent of estuarine habitat; rehabilitating and enhancing floodplain connectivity; improving flow conditions; modifying or removing physical passage barriers; improving riparian conditions; and reducing toxicity and pollutants.

2.2.2.2.2 Central California Coast Coho Salmon ESU Status

The CCC coho ESU was listed as endangered under the ESA on June 28, 2005 (70 FR 37160). This includes naturally spawned coho salmon encompassing reaches of all rivers (including estuarine areas and tributaries) between Punta Gorda and San Lorenzo River; including two streams entering the San Francisco Bay: (1) Arroyo Corte Madera Del Presidio; and (2) Corte Madera Creek (NMFS 2012a).

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

Brown *et al.* (1994) estimated that annual spawning numbers of coho salmon in California ranged between 200,000 and 500,000 fish in the 1940s, which declined to about 100,000 fish by the 1960s, followed by a further decline to about 31,000 fish by 1991. More recent abundance estimates vary from approximately 600 to 5,500 adults (Good *et al.* 2005b). Past status reviews (Williams *et al*. 2011a) indicate that the CCC coho salmon are likely continuing to decline. CCC coho salmon have also experienced acute range restriction and fragmentation. (Adams 1999) found that in the mid 1990s coho salmon were present in 51 percent (98 of 191) of the streams where they were historically present, and documented an additional 23 streams within the CCC coho salmon ESU in which coho salmon were found for which there were no historical records. Recent genetic research in progress by both the NMFS Southwest Fisheries Science Center and the Bodega Marine Laboratory has documented a reduction in genetic diversity within subpopulations of the CCC coho salmon ESU (Bjorkstedt *et al.* 2005). The influence of hatchery fish on wild stocks has also contributed to the lack of 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 of the lower Russian River, including Austin Creek and Dry Creek.

None of the five diversity strata defined by (Bjorkstedt *et al.* 2005) currently support viable populations. According to Williams *et al.* (2016), recent surveys suggest CCC coho abundance has improved slightly since 2011 within several independent populations (mainly north of SF bay), although all populations remain well below their high-risk dispensation thresholds identified by (Spence *et al*. 2008). The Russian River and Lagunitas Creek populations are relative strongholds for the species compared to other CCC ESU populations, the former predominantly due to out-planting of hatchery-reared juvenile fish from the RRCSCBP. The overall risk of CCC coho salmon extinction remains high, and the most recent status review reaffirmed the ESU's endangered status (Williams *et al.* 2016).

The Recovery Plan for the CCC coho salmon (NMFS 2012a) outlines a short term strategy to prevent extinction of the ESU. The ESU recovery actions are summarized as follow: Immediately implement restoration to improve freshwater survival of all life stages; continue and seek long-term funding for population and habitat monitoring; incentivize landowners to maintain forestlands and restore unproductive timberland; pursue protection and preservation of key habitats (e.g., Conservation Banks); and establish CCC coho salmon plan outreach and implementation groups across the ESU.

Critical Habitat and Physical or Biological Features for California Central Coast Steelhead and California Central Coast Coho Salmon

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

- freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;

- freshwater rearing sites with:

- water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
- water quality and forage supporting juvenile development; and
- natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

- freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

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 24049).

The condition of CCC coho salmon and CCC steelhead critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that currently depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat[10]: logging, agriculture, mining, urbanization, stream channelization and bank stabilization, 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/quantity, 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.

[10] 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.

2.2.2.3 Northern California

2.2.2.3.1 California Coastal Chinook Salmon ESU Status

The CC Chinook salmon ESU was listed as a threatened species in 1999 (64 FR 50394). This ESU includes all Chinook populations from streams immediately south of the Klamath River in northern California to and including the Russian River. The threatened status of this ESU was reaffirmed in 2005 and seven small artificial propagation programs were also added to the listed ESU (70 FR 37160). NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU. Since 2005, all seven artificial programs have been terminated. Genetic data from Chinook salmon populations spawning in streams south of the Russian River and in several tributaries to San Francisco Bay suggest that populations spawning between the Russian River and Golden Gate are part of the CC Chinook salmon ESU (Williams *et al*. 2011c) and should be included in the listing.

Bjorkstedt *et al.* (2005) determined that the CC Chinook salmon ESU historically comprised 15 independent populations (*i.e*., 10 functionally independent and 5 potentially independent) of fall run Chinook salmon and six independent populations (all functionally independent) of spring-run Chinook salmon. The lack of historical data on Chinook salmon in smaller watersheds within this ESU, none of which currently support persistent populations of Chinook salmon, confounded efforts to identify dependent populations. The TRT tentatively identified 17 watersheds as possibly supporting dependent populations, but suggested that perhaps only two of these were consistently occupied by Chinook salmon. Populations were assigned to four geographically based strata, with two of these strata further subdivided into fall-run and spring run life history types (Bjorkstedt *et al.* 2005 modified in Spence *et al*. 2008). Based on the limited ancillary data that was available, the TRT concluded that six independent populations of fall Chinook salmon in this ESU were at high risk of extinction or possibly extinct, including the Ten Mile, Noyo, Big, Navarro, Garcia, and Gualala river populations. One population of fall-run Chinook was determined to be at moderate or high risk (Mattole River), and the remaining populations were deemed to be data deficient. All six putative historical populations of spring-run Chinook salmon were believed extinct (Spence *et al*. 2008).

A status review update by the Southwest Fisheries Science Center (SWFSC) in 2011 concluded that the lack of population-level estimates of abundance for Chinook salmon populations in this ESU continues to hinder viability assessment (Williams *et al*. 2011c). However, based on a consideration of all new information since the previous status review (Good *et al.* 2005a), the SWFSC did not find evidence of a substantial change in the biological status of the ESU. The status review did, however, cite several concerns about the ESU including the apparent loss of populations from one diversity stratum, the loss of the spring-run life history type from two diversity strata, and the diminished connectivity between populations in the northern and southern halves of the ESU. These concerns were generally recognized at the time of the previous status review, but were considered more significant in this review given the recently developed population viability criteria for this ESU. Overall, the SWFSC update concluded that the biological status of this ESU is unchanged from that described by (Good *et al.* 2005a) who considered it likely to become endangered in the foreseeable future. In 2016, NMFS (2016) completed another status review update and concluded that the collective risk to the persistence of the CC Chinook ESU has not changed significantly since the 2011 status review.

Current Distribution and Abundance

A common theme in the ESA status determinations for Chinook salmon is the sparseness of spawner abundance data (O'Farrell *et al.* 2012). There is a lack of adult spawner estimates spanning 3-4 generations for any of the populations, which prevents application of the viability criteria developed for this ESU (Spence *et al*. 2008). Additionally, the lack of historical population abundance estimates is a major uncertainty. For example, Chinook salmon are periodically observed in many mid-sized watersheds (i.e., Big River, Ten Mile River, Noyo River, Navarro River, Garcia River, and Gualala River) in the region between Cape Mendocino and the Russian River (Spence et al. 2008). However, these watersheds currently do not appear to support persistent populations, and there remains substantial uncertainty about whether they did historically (Bjorkstedt *et al.* 2005). The paucity of historical evidence may reflect in part the fact that substantial modification of habitats due to logging, splash-damming, and other forestry-related activities had already taken place by the late-1800s (Spence *et al*. 2008). Population trends throughout most of the ESU appear to be negative, and some local populations may have been extirpated.

Low abundance, generally negative trends in abundance, reduced distribution, and profound uncertainty as to risk related to the relative lack of population monitoring in California have contributed to NMFS' concern that CC Chinook salmon are at risk of becoming endangered in the foreseeable future throughout all or a significant portion of their range (NMFS 2011a). Where monitoring has occurred, Good *et al.* (2005a) found that historical and current information indicates that CC Chinook salmon populations are depressed. Uncertainty about abundance and natural productivity, and reduced distribution are among the risks facing this ESU. Concerns regarding the lack of population-level estimates of abundance, the loss of populations from one diversity stratum, as well as poor ocean survival contributed to the conclusion that CC Chinook salmon are "likely to become endangered" in the foreseeable future (Good *et al.* 2005a, NMFS 2011, Williams et al. 2016).

In the 1960s, Chinook salmon abundance in the Eel River Basin was considerably higher than other basins in the CC Chinook salmon ESU (Good *et al.* 2005a). CC Chinook appear to have substantially declined from historical abundance (Good *et al.* 2005a), though little reliable annual population data exists. Current population trends throughout most of the CC Chinook salmon ESU appear to be negative; however, very little recent data is available (Good *et al.* 2005a).

Factors Responsible for Decline

At the time of listing, Chinook salmon and their habitat within the range of this ESU were adversely affected by logging, road construction, urban development, mining activities, agriculture, ranching and recreation (NMFS 2008b, 64 FR 50394, 70 FR 37160). These activities resulted in the loss, degradation, simplification, and fragmentation of Chinook salmon habitat. A wide range of impacts resulted from these activities including: alteration of steam banks and channel morphology, alteration of ambient water temperatures, degradation of water quality, elimination of spawning and rearing habitat, elimination of spawning gravels and large woody debris, removal of riparian vegetation and increased stream sedimentation. The effects of periodic flood events exacerbate the adverse effects of these activities. Additionally, the distribution of the Chinook salmon in this ESU has been curtailed by dam construction. The spring-run life history form, which historically spawned and reared in upstream portions of certain watersheds, was heavily impacted by construction of dams and has been completely extirpated from this ESU. Warm Springs and Coyote Dams in the Russian watershed and Scott Dam on the Eel were cited at the time of listing as curtailing or blocking access to spawning and rearing habitat within this ESU. Peters Dam on Lagunitas Creek was also cited as a migration barrier even though the watershed was not included in originally defined ESU.

Overutilization for recreational purposes is considered to be one of the primary reasons for the decline of the CC Chinook salmon ESU. Chinook salmon have supported, and continue to support tribal, commercial, and recreational fisheries, and artificial production, supplementation, and broodstock collection activities. Overfishing in the early days of European settlement depleted many Chinook salmon stocks prior to the impact of more recent habitat degradation (NMFS 1998). Unsustainable harvest rates after extensive habitat degradation likely contributed to further decline of Chinook salmon populations.

Both freshwater and ocean harvest impacts have been reduced over time by active management. Freshwater harvest is managed by CDFW. Ocean harvest is managed by the Pacific Fisheries Management Council (PFMC). Although modern harvest rates have not been estimated directly for the CC Chinook salmon ESU, they may be comparable to rates on Klamath fall-run Chinook salmon (NMFS 1998). Past ocean harvest rate for this population was estimated at 21 percent (PFMC 1996 as cited in NMFS 1998), and freshwater and estuarine harvest rate between 25-30 percent (PFMC 1996 as cited in NMFS 1998).

Artificial propagation of Chinook salmon and other salmonids was also identified as a potential threat to this and other ESUs at the time of their listing. Artificial propagation of salmonids can have a wide range of beneficial or detrimental effects on salmon populations (64 FR 50394, 70 FR 37160). At the time of the status review in 2005, seven artificial propagation programs were considered part of this ESU and eventually listed. Most of these artificial propagation programs were small, cooperative programs authorized by the CDFG. In making its 2005 listing finding for this ESU, we considered the effects of these hatchery programs on the viability of the naturally spawning populations of Chinook salmon in this ESU. In general, our assessment concluded that these programs slightly increased the abundance of Chinook salmon in the ESU, but did not have any beneficial (or adverse) impacts on productivity, spatial structure or diversity of Chinook salmon populations, in large part because the programs were very small and broadly distributed over the ESU. Overall, we concluded that hatchery programs in this ESU did not provide significant benefits to the ESU and could have potential adverse impacts. Since the status review in 2005, all seven artificial propagation programs have been terminated and they no longer have any impacts on naturally spawning Chinook salmon populations within the ESU.

At the time of listing, several natural factors were identified that could adversely affect Chinook salmon populations in this ESU including variability in ocean habitat conditions, drought, flooding, fire, and landslides. Although Chinook salmon and other salmonids clearly survived such natural events over the millennia, there was concern that these types of factors could threaten Chinook populations if coupled with deteriorating freshwater habitat conditions. Cyclic ocean conditions, for example, could affect food supply, predator distribution and abundance, migratory patterns, and overall survival (NMFS 1998). Droughts and floods might reduce Chinook salmon spawning, rearing, and migration habitat, particularly in conjunction with previously described land and water use activities that modify or degrade habitat conditions. Similarly, fire events, particularly if coupled with modified or degraded habitat conditions, could affect woody debris recruitment, shade, and soil stability. Landslides could affect riparian vegetation and sedimentation.

Critical Habitat and Physical or Biological Features for California Coastal Chinook Salmon

Critical habitat for CC Chinook salmon was designated as occupied watersheds from the Redwood Creek watershed, south to and including the Russian River watershed (70 FR 52488).

Designated critical habitat for CC Chinook salmon steelhead includes the stream channels up to the ordinary high-water line (50 CFR 226.211). In areas where the ordinary high-water line has not been defined pursuant to 50 CFR 226.211, the lateral extent is defined by the bankfull elevation. Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

Humboldt Bay and the Eel River estuary are designated as critical habitat for the CC Chinook salmon ESU. Some areas within the geographic range were excluded due to economic considerations. Critical habitat was not designated on Indian lands. Designated critical habitat for CC Chinook salmon overlaps the action area. In designating critical habitat for CC Chinook salmon, NMFS focused on areas that are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. The critical habitat designation for these species identifies the known physical and biological features that are necessary to support one or more Chinook salmon life stages, including: (1) freshwater spawning, (2) freshwater rearing, (3) freshwater migration, (4) estuarine areas, (5) nearshore marine areas, and (6) offshore marine areas. Essential elements of CC Chinook salmon critical habitats 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, (10) safe passage conditions, and (11) salinity conditions (70 FR 52488).

The condition of CC Chinook salmon critical habitat, specifically its ability to provide for their conservation, is 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, freshwater and estuarine wetland loss, and water withdrawals for irrigation. All of these factors were identified when CC Chinook salmon were listed as threatened under the ESA, and they all continue to affect this ESU. However, efforts to improve CC Chinook salmon critical habitat have been widespread and are expected to benefit the ESU.

The Multispecies Recovery Plan (NMFS 2015) for the CC Chinook identifies multiple recovery actions, including: increasing quality and extent of estuarine habitat; rehabilitating and enhancing floodplain connectivity; improving flow conditions; modifying or removing physical passage barriers; improving riparian conditions; and reducing toxicity and pollutants.

2.2.2.3.2 Southern Oregon Northern California Coho Salmon Status

On July 19, 1995, NMFS announced its status finding and intent to propose the SONCC coho salmon ESU, which includes populations spawning from the Elk River (Oregon) in the north to the Mattole River (California) in the south, as threatened under the ESA. Our finding was published in the Federal Register on July 25, 1995 (60 FR 38011) and made final on April 25, 1997. NMFS published its final decision to list SONCC coho salmon as threatened under the ESA on May 6, 1997 (62 FR 24588).

In 2005, NMFS reaffirmed SONCC coho salmon status as a threatened species and listed three hatchery stocks as part of the ESU (70 FR 37160). NMFS completed a status review of the SONCC coho salmon ESU (Williams *et al*. 2011a) and determined that the ESU, although trending in declining abundance, should remain listed as threatened. The primary factors affecting diversity of SONCC coho salmon appear to be low population abundance, ocean survival conditions, and drought effects (Williams *et al*. 2011a). The most recent status review was completed in 2016, and NMFS determined that drought and ocean conditions seem to be driving recent declines in abundance, however there does not appear to be a change in extinction risk since the 2011 status review (Williams *et al*. 2016).

Population Viability

Abundance

Quantitative population-level estimates of adult spawner abundance spanning more than 9 years are scarce for the SONCC ESU coho salmon. New data since publication of the previous status review (Good *et al.* 2005b) consists of continuation of a few time series of adult abundance, expansion of efforts in coastal basins of Oregon to include SONCC ESU coho salmon populations, and continuation and addition of several population 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 scale.

Although long-term data on coho salmon abundance in the SONCC-Coho Salmon ESU are scarce, all available evidence from available trends since 2011 assessment (Williams *et al*. 2011) indicate little change since the 2011 assessment (Williams *et al.* 2016). 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, which can be thought of as the minimum number of adults needed for survival of a population.

Populations that are under depensation have increased likelihood of being extirpated. To summarize conditions across the ESU, 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. One population contains critically low numbers (i.e., Upper Mainstem Eel River; with only a total of 7 coho salmon adults counted at the Van Arsdale Fish Station in over six decades) (Jahn 2010).

SONCC coho salmon populations have declined dramatically throughout their range (CDFG 2002, Williams *et al.* 2006). The highest recorded count through the Van Arsdale Fish Station was 47 in 1946-1947 (Harris 2015). In 1965, 14,000 adult coho salmon were estimated in the entire Eel River Basin (CDFG 1965 as cited in Good *et al.* 2005b), while only 4,400 were estimated in 1984 (Wahle and Pearson 1987 as cited in Good *et al.* 2005b) and around 2,000 from 1987–1991 (Brown *et al.* 1994 as cited in Good *et al.* 2005b). Recent status reviews indicate populations continue to be depressed relative to historical numbers, with numerous populations extirpated from tributaries throughout their historical range (Williams *et al.* 2011a, Williams *et al.* 2016).

Diversity

Williams *et al.* (2006) classified SONCC coho salmon populations as dependent or independent based on their historic population size. Independent populations are populations that historically would have had a high likelihood of persisting in isolation from neighboring populations for 100 years and are rated as functionally independent (FI) and potentially independent (PI). Core population types are independent populations judged most likely to become viable most quickly. Non-core 1 population types are independent populations judged to have lesser potential for rapid recovery than the core populations. Non-Core 2 populations were identified in response to the requirement that “most” (not all) independent populations should be at moderate risk of extinction, which allows that some independent populations do not need to be either at moderate risk or low risk. For some independent populations, there is little to no documentation of coho salmon presence in the last century, and prospects are low for the population to recover to numbers at least four spawners per kilometer of intrinsic potential habitat. These populations are categorized as Non-Core 2 populations (NMFS 2014). Dependent populations are populations that historically would not have had a high likelihood of persisting in isolation for 100 years. These populations relied upon periodic immigration from other populations to maintain their abundance. Two ephemeral populations are defined as populations both small enough and isolated enough that they are only intermittently present (McElhany *et al.* 2000, Williams *et al.* 2006, NMFS 2014b).

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. Williams *et al.* (2011a) indicated that the biological status of the SONCC coho salmon ESU has worsened since 2005, and the primary factors currently affecting diversity of SONCC coho salmon appear to be low population abundance, ocean survival conditions, and drought.

Distribution

The historical population structure (Williams *et al.* 2006), coho salmon status reviews (Good *et al.* 2005, Williams *et al*. 2011a, William *et al.* 2016), and the presence and absence update for the northern California portion of the SONCC coho salmon ESU (Brownell *et al.* 1999) summarize historical and current distributions of SONCC coho salmon in northern California.

The distribution of SONCC coho salmon within the ESU is reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which SONCC coho salmon are now absent (NMFS 2001, Good *et al.* 2005b, Williams *et al.* 2011b). Scientists at the

NMFS Southwest Fisheries Science Center compiled a presence-absence database for the SONCC coho salmon ESU (NMFS 2014b) using information for coho salmon streams listed in (Brown and Moyle 1991) as well as other streams where NMFS found historical or recent evidence of coho salmon presence. (Brown and Moyle 1991) identified 396 streams within the ESU as historic coho salmon streams.

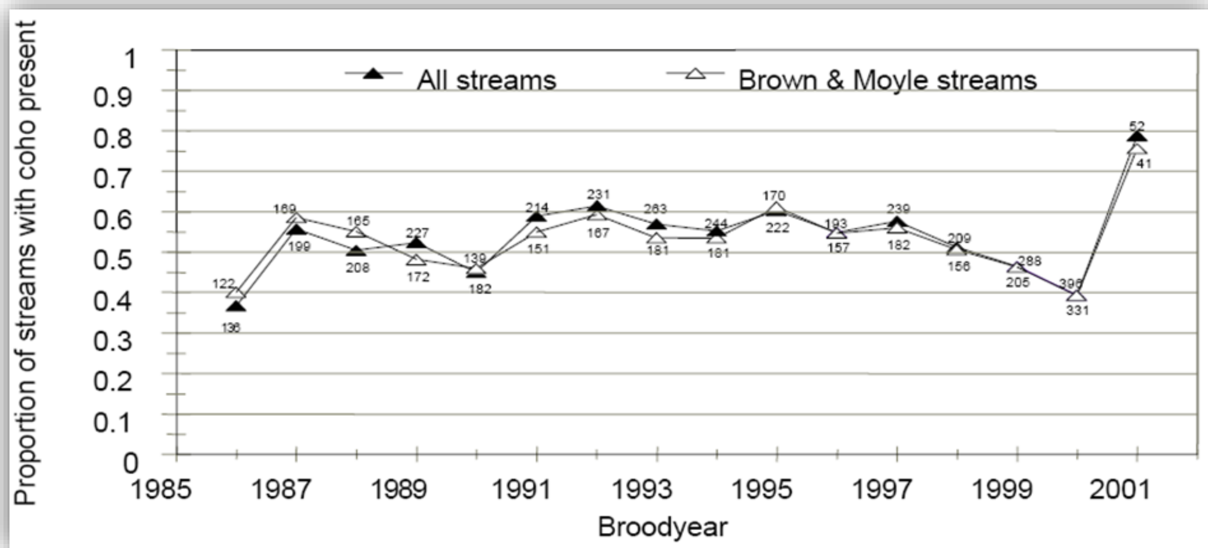

Figure 1. Number of streams with coho salmon present (number of streams surveyed reported next to data point)

Using the NMFS database, (Good *et al.* 2005b) compiled information on the presence of coho salmon in streams throughout the SONCC ESU (Figure 1), which closely matched the results of (Brown and Moyle 1991). (Garwood 2012) compiled coho salmon data through 2004 to generate a historical coho salmon stream list for the California watersheds of the SONCC ESU. (Garwood 2012) verified the presence of juvenile coho in 325 of the streams from the (Brown and Moyle 1991) study, and identified 217 additional streams. From 2001 to 2003, the California Department of Fish and Game (CDFG) conducted 628 surveys in 301 streams across the California portion of the SONCC ESU. Coho salmon were detected in 153 of 245 sampled historic coho salmon streams (Garwood 2012).

The number of streams and rivers currently supporting coho salmon in this ESU has been greatly reduced from historical levels, and watershed-specific extirpations of coho salmon have been documented (Brown et al. 1994, CDFG 2004, Good *et al.* 2005b, Moyle *et al*. 2008, Yoshiyama and Moyle 2010). In summary, information on the SONCC ESU of 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 (Williams *et al.* 2011b). However, extant populations can still be found in all major river basins within the ESU (70 FR 37160).

Given that all diversity strata are occupied (Williams *et al.* 2011b), the spatial structure of the SONCC coho salmon ESU is broadly distributed throughout its range. However, extirpations, loss of brood years, and sharp declines in abundance (in some cases to zero) of SONCC coho salmon in several streams throughout the ESU indicate that the SONCC coho salmon's spatial structure is more fragmented at the population-level than at the ESU scale.

Factors Responsible for Decline

The factors that caused declines in the SONCC ESU of coho salmon include hatchery practices, climate change, ocean conditions, habitat loss due to dam building, degradation of freshwater habitats due to a variety of agricultural and forestry practices, water diversions, urbanization, over-fishing, mining; and severe flood events exacerbated by land use practices (Good et al. 2005, NMFS 2014).

Sedimentation and loss of spawning gravels associated with poor forestry practices and roadbuilding are particularly chronic problems that can reduce the productivity of salmonid populations. Non-native Sacramento pikeminnow (Ptychocheilus grandis) have been observed in the Eel River basin and could be acting as predators on juvenile steelhead as thermal conditions lead to niche overlap of the two species (Good et al. 2005). Droughts and unfavorable ocean conditions during the late 1980s and early 1990s were identified as likely causes of decreased abundance of SONCC coho salmon (Good et al. 2005). Reduced flows can cause increases in water temperature, resulting in increased heat stress to fish and thermal barriers to migration.

MacFarlane et al. (2008) compared data on adult returns of returning coho salmon in California for return season 2004/05, compared to subsequent adult returns of their progeny in return year 2007/08. The data indicated a 73 percent decline in returning adults in 2007/08 (offspring from 2004/2005 adults), compared to adult returns in 2004/2005. MacFarlane et al. (2008) speculated that because the spatial extent of the decline observed between coho parent and subsequent returning adult offspring was wide-ranging throughout California and Oregon, ocean conditions were the main causative mechanism for decline. MacFarlane et al. (2008) further supported their hypothesis with observations of low adult Chinook returns to California that as juveniles, experienced sub-optimal ocean conditions during the same time as did coho juveniles.

NMFS (2014) describes climate change impacts as detrimental to Pacific salmon through altered runoff patterns causing a precipitation shift from snow to rain, earlier snowmelt, lower summer flows, and more intense storms that will increase peak flows in freshwater. When combined with ocean acidification and large ocean processes (e.g. El Nino, Southern Oscillation), climate change is expected to reduce ocean productivity and further alter estuarine habitat as sea level rises. Warmer winter air temperatures will decrease the snowpack in northern California and southern Oregon by up to 75 percent by 2040 and nearly 100 percent by 2080 (Doppelt et al. 2008) resulting in earlier and higher high flows, and earlier and lower low flows.

Battin et al. (2007) predicted that Chinook salmon (used here as a surrogate for coho salmon) spawner capacity throughout the Pacific Northwest was proportional to minimum discharge during the spawning period; reduction trends in flow would result in reductions in spawning capacity due to habitat limitations. Widespread declines in springtime snow water equivalent have occurred in much of the North American West since the 1920s, especially since the midtwentith century (Knowles and Cayan 2004, Hamlet et al. 2005, Regonda et al. 2005, Mote 2006). These trends have resulted in earlier onsets of springtime snowmelt and stream flow across western North America (Regonda et al. 2005, Stewart et al. 2005), as well as lower flows in the summer (Stewart et al. 2005). Low flows are also important for juvenile Coho due to space and food limitations, while low flows may be associated with temperature limitations in other areas (Ebersole et al. 2009).

Past forestry practices have harvested canopy-creating trees from stream-side habitat affects cover from predation, water temperature, the watershed's ability to absorb precipitation, water flow timing, erosion, bank stability, retention of in-stream woody debris, recruitment of large woody debris, and habitat complexity. Removal of near-stream vegetation can result in increased water temperature, both short- and long-term (Moring et al. 1994, cited by CDFG 2004). The decrease in habitat complexity, loss of stream function, and loss of access to accessible off-channel habitat, and temperature refugia have contributed to reduced summer and rearing capacity for juvenile coho salmon (CDFG 2002).

Hatchery practices as a causative mechanisms of salmonid decline include hatchery straying and mixing with wild spawners where the resulting progeny exhibit lower survival then their wild stock counterparts (McGinnity et al. 2003, Kostow 2004), ultimately leading to a reduction in the reproductive success of the wild stock (Reisenbichler and McIntyre 1977, Fleming et al. 2000, Chilcote 2003, Araki et al. 2007). Flagg et al. (2000) found that, except in situations of low wild fish density, increasing releases of hatchery fish can negatively impact naturally produced fish through habitat displacement. 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 (used here as a surrogate for coho salmon) 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 wild salmonids in the ocean can also lead to density-dependent mechanisms that effect wild salmonid populations (Beamish et al. 1997, Levin et al. 2001, Sweeting et al. 2003), especially during periods of poor ocean productivity (Beamish et al. 1997, Levin et al. 2001, Sweeting et al. 2003).

Dam operations disrupt hydrologic signals that salmon use throughout their life history by dampening peak flows and increase low flows—the converse of climate change. Dam construction has limited, or blocked upstream migration access to spawning and rearing habitat and remains one of the single most disruptive anthropogenic factors to decline (NMFS 2014).

Critical Habitat and Physical or Biological Features for Southern Oregon Northern California Coho

Designated critical habitat for SONCC coho salmon encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River in Oregon, inclusive (64 FR 24049). Excluded are: (1) areas above specific dams identified in the Federal Register notice; (2) areas above longstanding natural impassible barriers (i.e., natural waterfalls); and (3) tribal lands. The area described in the final rule represented the current freshwater and estuarine range of coho salmon. Land ownership patterns within the coho salmon ESU analyzed in this document and spanning southern Oregon and northern California are 53 percent private lands; 36 percent Federal lands; 10 percent State and local lands; and 1 percent Tribal lands.

The designated critical habitat for SONCC coho salmon is separated into five essential habitat types of the species' life cycle. The five essential habitat types include: (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 SONCC 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 24049).

The condition of SONCC coho salmon critical habitat at the ESU scale, specifically its ability to provide for the species' conservation, has been degraded from conditions known to support viable salmonid populations that contribute to survival and recovery of the species. NMFS determined that present depressed population conditions are, in part, the result of human-induced factors affecting critical habitat, including: intensive timber harvesting, agricultural and mining activities, urbanization, stream channelization, dams, wetland loss, and water withdrawals for irrigation. All of these factors were identified when SONCC coho salmon were listed as threatened under the ESA, and they continue to affect this ESU (NMFS 2014) However, efforts to improve coho salmon critical habitat have been widespread and are expected to benefit the ESU over time (NMFS 2014).

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 thousands of acres of upland, riparian, and wetland habitat have been treated (NMFS 2007b). Therefore, the condition of SONCC coho salmon critical habitat is likely improved or trending toward improvement compared to when it was designated in 1999.

SONCC coho salmon are dependent upon complex, low gradient habitats for winter rearing, and will express diversity by overwintering in low-gradient, off-channel and estuarine habitats when they are available. The lack of complex aquatic habitat, and much decreased access to floodplains and low gradient tributaries are common features of current critical habitat conditions within the SONCC coho salmon ESU (NMFS 2014). The Recovery Plan also describes that land use activities (e.g., timber harvest, road building, etc.) that occur upstream of low gradient streams, still affect the habitat within low gradient streams by reducing the amount of large wood and shade available and by increasing the amount of sediment that routes through the valley bottom habitats. Recovery actions include removal of or establishment of passage at dams; reducing unpermitted diversions; ensuring sufficient water quantity and quality; restoring in-channel habitat and upslope ecological function; and creating suitable estuarine nurseries.

2.2.2.3.3 Northern California Steelhead DPS Status

NC steelhead were originally defined as an ESU that included resident fish, and the anadromous fish were listed as threatened in 2000 (65 FR 36074). In 2006, NMFS redefined the NC steelhead ESU as a steelhead-only DPS (no resident fish), and reaffirmed that this DPS was a threatened species under the ESA (71 FR 834). The NC steelhead DPS comprises winter- and summer-run steelhead populations from Redwood Creek (Humboldt County) southward to, but not including, the Russian River.

Little historical abundance information exists for the naturally spawning portion of the NC steelhead DPS. A Biological Review Team (BRT) established by NMFS conducted a status review for West Coast steelhead and reported their conclusions in 1996 (Busby et al.). Although data for the NC steelhead DPS were limited, analysis by the BRT led to the following conclusions: (1) population abundances were low relative to historical estimates; (2) recent trends were downward; and (3) summer-run steelhead abundance was "very low" (Busby *et al.* 1996).

In 2003, another BRT convened to analyze updated biological information for West Coast steelhead and reported their conclusions in 2005 (Good *et al.* 2005a). Updated time series of adult abundance data suggested a downward trend in summer-run steelhead in the Middle Fork Eel River, the largest extant population of summer steelhead in the NC steelhead DPS (Good *et al.* 2005a). Similarly, analysis of new time series data for adult summer-run steelhead in the Mad River showed a downward trend.

Since publication of the 2005 status review (Good *et al.* 2005a), significant new genetic data became available for steelhead populations across much of coastal California, suggesting that changes in the DPS composition could be warranted for NC steelhead. A BRT was convened to evaluate these new data and other relevant information related to coastal steelhead DPS composition. This review was based on the existing DPS designations. As a result of the review, NMFS retained the NC steelhead DPS designation as a threatened species on April 14, 2014 (79 FR 20802).

The NC steelhead DPS includes all naturally spawning winter- and summer-run populations of *O. mykiss* (steelhead) originating below natural and manmade impassable barriers in California coastal river basins from Redwood Creek in Humboldt County, to just south of Gualala River in 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. The half-pounder life history also occurs within the range of this DPS, specifically in the Mad and Eel rivers. The TRT identified 29 "functionally independent", 22 "potentially independent", and at least 67 "dependent" populations in the NC steelhead DPS (Bjorkstedt *et al.* 2005); with modifications described in (Spence *et al*. 2008). Analysis of genetic data provided support for, and aided in interpretation of population type assignment (NMFS 2007b). The TRT defined five diversity strata in the NC steelhead DPS. Within three of these strata, populations were further subdivided according to life history type, with summer-run and winter-run populations constituting distinct substrata (Bjorkstedt *et al.* 2005, Spence *et al*. 2008, NMFS 2007b).

Extant summer-run steelhead populations are found in Redwood Creek and the Mad, Eel (Middle Fork) and Mattole Rivers. (Spence *et al*. 2008) concluded that adult abundance information for independent populations of steelhead in this DPS were insufficient to rigorously evaluate their viability using criteria developed by the TRT. However, the TRT concluded Bucknell Creek and Soda Creek are at a moderate/high risk of extinction based on low return counts at Van Arsdale Fish Station and the dominance of those counts by hatchery fish. The Upper Eel River was consider to be at a high risk of extinction due to the loss of habitat above Scott Dam and the high proportion of hatchery fish returning to Van Arsdale. Smaller populations including the Noyo River, Hare Creek, Pudding Creek, and Casper Creek were deemed at moderate risk of extinction if fish abundance remained unchanged over time (Spence *et al*. 2008).

The status review update conducted by the SWFSC concluded that the lack of population-level estimates of abundance for steelhead populations in this DPS continues to hinder assessment of its status (Williams *et al*. 2011a). The status review did, however, cite several concerns about the DPS including the continued depressed status of two remaining summer run populations in the DPS (Redwood Creek and Mattole River), the high number of hatchery fish in the Mad River basin, and the uncertainty about the relative abundance of hatchery and wild spawners in the Mad River. The previous status review of (Good *et al.* 2005a) concluded that the population was likely to become endangered in the foreseeable future. Based on a consideration of all new substantive information on the biological status of the DPS, the SWFSC concluded that its biological status was unchanged (Williams *et al*. 2011a). In 2016, (NMFS 2016e) completed another status review and concluded that the collective risk to the persistence of the NC steelhead DPS has not changed significantly since the 2011 review. In summary, the best available updated information on the biological status of the NC steelhead DPS and the threats it faces indicate that it continues to remain a threatened species.

Population Viability

Abundance

NC steelhead have declined throughout their range (McEwan and Jackson 1996, Busby *et al.* 1996, Good *et al.* 2005a). The highest recorded count through the Van Arsdale Fish Station was 9,528 in 1944-1945 (Harris 2015). Busby *et al.* (1996) reported an annual average of about 4,300 adult steelhead at Van Arsdale Fish Station (representing only a small fraction of entire Eel River run) from the 1930s– 1940s, and only 1,300 in the 1980s. Steelhead returns to the Van Arsdale Fish Station have been recorded for many spawning seasons, and during 2010/2011, 151 steelhead returned to the station, during 2011/2012, 296 returned, during 2012/2013, 186 returned, during 2014/2015, 217 returned, and 174 steelhead had returned during the 2015/2016 season (Friends of the Eel River 2016).

Steelhead abundance has been monitored at three other dams in the NC steelhead DPS since the 1930s: 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, CDFG estimated steelhead spawning in many rivers in this DPS 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.

Busby *et al.* (1996) and Good *et al.* (2005a) summarized current abundance estimates, and stated that: (1) population abundances are low compared to historical estimates; (2) recent trends are downward (except for a few small summer-run populations); and (3) summer-run steelhead abundance was "very low" (Good *et al.* 2005a). The 2011 status review (Williams et al. 2011c) cited lack of data on population level abundances, particularly time series data within the DPS, as a major source of uncertainty, hindering the assessment of NC steelhead status. Population level abundance estimates were only available for 4 of the 42 independent winter-run steelhead populations and for 1 of 10 summer-run populations in the DPS. Trends for all five independent populations are negative, three of which are significant (Williams *et al*. 2011a). Of the six winter-run and three summer-run partial population estimates, trends were not calculated by NMFS because the data sets were too short (Williams *et al*. 2011a). Of the six remaining that had sufficient data, two partial populations are exhibiting significant negative trends. Only one partial population is exhibiting a significant positive trend ($p>0.05$).

Busby *et al.* (1996) and Good *et al.* (2005a) concluded that the NC steelhead DPS was not in danger of extinction, but was likely to become endangered in the foreseeable future. In the 2011 status review update, Williams et al. (2011c) found that historical and current information indicates that NC steelhead populations are depressed in basins where they are being monitored. Only the Middle Fork Eel River summer-run steelhead populations approached low-risk thresholds established by the Technical Review Team (TRT) (Williams *et al*. 2011a). The TRT also found that the summer-run population in Redwood Creek showed chronically low numbers during all surveys, suggesting that this population continues to be at a high risk of extinction (Williams *et al*. 2011a).

Land use activities associated with logging, road construction, urban development, mining, agriculture, ranching, and recreation have resulted in the loss, degradation, simplification, and fragmentation of NC steelhead habitat and caused resulting declines in NC steelhead populations (NMFS 1996). Associated impacts of these activities include: alteration of stream bank and channel morphology, alteration of ambient stream water temperatures, degradation of water quality; elimination of spawning and rearing habitats; fragmentation of available habitats; elimination of downstream recruitment of spawning gravels and LWD; removal of riparian vegetation resulting in increased stream bank erosion; and increased sedimentation input into spawning and rearing areas (NMFS 1996).

Diversity

Millions of steelhead from outside the DPS have been stocked in rivers in the NC steelhead DPS since the 1970s. Bjorkstedt *et al.* (2005) documented 39 separate releases of steelhead, many of which 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 in the Eel River (Bjorkstedt *et al.* 2005). Over ten years, more than one-half million yearlings were reared and released in this way, and this practice may have reduced the effectiveness of adult homing to the Eel River (Bjorkstedt *et al.* 2005). In addition, abundance of summer-run steelhead was considered "very low" in 1996 (Good *et al.* 2005a), indicating that an important component of life history diversity in this DPS may be at risk. In the 2011 status review (Williams *et al*. 2011a), NMFS determined that the potential risks of stochastic processes associated with small population size have increased in the past five years since the previous review (Good *et al.* 2005a), likely placing populations of NC steelhead at a higher risk of extinction.

As described for SONCC coho salmon, (Spence *et al*. 2008) classified NC steelhead populations as dependent or independent based on their historic population size and ability to persist in isolation. 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. The most recent status review (NMFS 2016i) indicated that the biological status of the NC steelhead DPS has not changed since 2011.

Distribution

With few exceptions, NC steelhead are present wherever streams are accessible to anadromous fish and have sufficient flows. Experts consulted during the 2005 status review gave this DPS a mean risk score of 2.2 (out of 5) for the spatial structure and connectivity category (Good *et al.* 2005a), indicating it is unlikely that this factor contributes significantly to risk of extinction by itself, but there is some concern that it may, in combination with other factors.

As the ‘default’ historic spatial processes described by McElhany *et al*. (2000) have likely not been preserved, NMFS (Williams *et al*. 2016) concluded in the most recent status review that winter steelhead continue to inhabit most of the watersheds in which they historically occurred, thus all diversity strata within the DPS appeared to be represented by extant populations. However, given this information, there is still little information available for assessing whether conditions have improved or worsened over the past 5 years (Williams *et al*. 2016).

Although large wood features such as debris jams provide winter refuge for steelhead, cover consisting of interstitial spaces in cobble or boulder substrate is considered the key attribute defining winter habitat suitability for juvenile steelhead (Hartman 1965, Chapman and Bjornn 1969, Meyer and Griffith 1997). Hartman (1965) and Bustard and Narver (1975) found that during high winter flows, juvenile steelhead seek refuge in interstitial spaces in cobble and boulder substrates that range in size from 10 to 40+ cm (4 to 16+ in). Initial observations from experiments conducted by Redwood Sciences Laboratory and Stillwater Sciences (unpublished data; cited in Humboldt County and Stillwater Sciences 2011) in artificial stream channels, indicate that juvenile steelhead respond to high flows by seeking cover deep within cobble and boulder substrate, suggesting that steelhead will seek refuge at least 1 to 2 times the depth of the median particle size (d50) in unembedded cobble/boulder substrate.

Since publication of the 2011 status review (Williams *et al.* 2011a), population-level estimates of abundance were available for less than 10% of independent populations of winter- and summer-run NC steelhead. Since that time, data has become available for 17 independent populations, as well as six dependent populations. The available information for winter-run and summer-run populations of NC steelhead do not suggest an appreciable increase or decrease in extinction risk. Most populations for which there are population estimates available remain well below viability targets; however, the short-term increases observed for many populations, despite the occurrence of a prolonged drought in northern California, suggests this DPS is not at immediate risk of extinction (Williams *et al.* 2016).

Factors Responsible for Decline

Land use activities associated with logging, road construction, urban development, gravel mining, agriculture, ranching, and recreation have resulted in the loss, degradation, simplification, and fragmentation of habitat for steelhead in this DPS which have led to population declines. Impacts associated with these activities include: alteration of stream bank and channel morphology; alteration of ambient stream water temperatures; degradation of water quality; elimination of spawning and rearing habitats; fragmentation of available habitats; elimination of downstream recruitment of spawning gravels and large woody debris; removal of riparian vegetation resulting in increased stream bank erosion; and increased sedimentation input into spawning and rearing areas (NMFS 1996). Land use practices can exacerbate the impact of flooding, and can cause substantial degradation to steelhead habitat (Busby *et al.* 1996).

Alteration of the natural hydrology through storage, withdrawal, conveyance, and water diversions for agriculture, flood control, domestic, and hydropower purposes have reduced or eliminated historically accessible habitat for steelhead. The Scott Dam on the Eel River has eliminated access to historical spawning and rearing habitat and has altered the natural flow regime within the basin (NMFS 1996). Modification of natural flow regimes has increased water temperatures, changed fish community structures, and depleted flows. A reduction in flow volume affects fish migration, spawning, and rearing, and reduces the flushing of sediments from spawning gravels, recruitment of gravel and transport of large woody debris (NMFS 1996).

As stated in the NMFS (2015) Multispecies Recovery Plan for the NC steelhead DPS, riparian wetland habitat in California has been reduced by over 90 percent (Dahl *et al*. 1991, Platts 1990, Armour 1991 as cited in NMFS 1996). The condition of the remaining riparian, wetland, and estuarine habitats for this DPS is largely degraded and at continued risk of loss or further degradation. The destruction or modification of riparian, wetland, and estuarine areas has resulted in the loss of important rearing and migration fish habitats (Dahl 2011).

Since the original listing of this DPS, in-stream gravel mining practices have improved in Northern California. Mining operations are permitted by the Corps and the permits in place contain numerous impact minimization measures aimed at reducing the effects of gravel extraction on steelhead and their habitat. However, even with minimization measures, gravel extraction reduces overall habitat complexity and reduces the quality and quantity of available pool habitat (Simon and Hupp 1992). Given the sensitivity of channels to disturbance (*i.e.,* current lack of floodplain and channel structure; low levels of instream wood), and the use of gravel extraction reaches by steelhead for rearing, gravel extraction is a threat to rearing juveniles and a moderate threat to adults that require resting habitat in pools during upstream migration (NMFS 2015b). Increased focus should be given to addressing the potential threats to this DPS from exposure to common pesticides that may constrain recovery.

Critical Habitat and Physical or Biological Features for Northern California Steelhead

NMFS designated critical habitat for seven of the ESUs/DPSs of Pacific salmon and steelhead, including NC steelhead, in September 2005 (70 FR 52488). Specific PBFs that are essential for the conservation of each species, were identified as: freshwater spawning sites; freshwater rearing sites; freshwater migration corridors; estuarine areas; nearshore marine areas; and offshore marine areas. Within the PBFs, essential elements of NC steelhead critical habitats 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, (10) safe passage conditions, and (11) salinity conditions (70 FR 52488).

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 steelhead in streams, rivers, lagoons and estuaries (50 CFR 226.211). In some cases, streams containing NC steelhead were not designated because the economic benefit of exclusion outweighed the benefits of designation, as in the North Fork Eel River. Native American tribal lands and U.S. Department of Defense lands were also excluded.

Designated critical habitat for NC steelhead and CC Chinook salmon steelhead includes the stream channels up to the ordinary high-water line (50 CFR 226.211). In areas where the ordinary high-water line has not been defined pursuant to 50 CFR 226.211, the lateral extent is defined by the bankfull elevation. Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

Similar to the current condition of SONCC coho salmon critical habitat, the current condition of NC steelhead critical habitat is degraded throughout most of the range of this species. Estuaries and lower river habitats are greatly reduced, in both area and condition, as the valley bottoms near the mouths of rivers are where most of the agricultural and urban development is concentrated. Levees constrain most estuaries and lower rivers in this DPS and prevent access to important off-channel rearing habitat. Upstream land uses increase the amount of sediment and warm water that enters low gradient streams and decreases the availability of large wood in these habitats.

The condition of NC steelhead critical habitat, specifically its ability to provide for their conservation, is degraded from conditions known to support viable salmonid populations. NMFS 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, freshwater and estuarine wetland loss, and water withdrawals for irrigation. All of these factors were identified when NC steelhead were listed as threatened under the ESA, and they all continue to affect this DPS. However, efforts to improve NC steelhead critical habitat have been widespread and are expected to benefit the DPS.

The Multispecies Recovery Plan (NMFS 2015) for the NC steelhead identifies multiple recovery actions, including: increasing quality and extent of estuarine habitat; rehabilitating and enhancing floodplain connectivity; improving flow conditions; modifying or removing physical passage barriers; improving riparian conditions; and reducing toxicity and pollutants.

2.2.2.3.4 Eulachon Southern DPS Status

The southern DPS of eulachon was listed as threatened on March 18, 2010 (75 FR 13012). All subpopulations of eulachon within Washington, Oregon, and California are included in the listing. The DPS extends from the Skeena River in British Columbia south to the Mad River in Northern California.

Areas in California where eulachon have been documented include the Russian River, Humboldt Bay and several nearby smaller coastal rivers (e.g., Mad River), and the Klamath River. Southern DPS eulachon spawn in the lower reaches of freshwater rivers and streams but they are primarily a marine fish spending over 95 percent of their lives in the Pacific Ocean (Duran 2008). Although there have been no long-term monitoring programs for eulachon in Northern California, large spawning aggregations were reported to have once regularly occurred in the Klamath River (Reclamation 2012).

Large spawning aggregations of eulachon were reported to have once regularly occurred in the Klamath River (Fry Jr. 1979, Moyle *et. al*. 1995, Larson and Belchik 1998, Moyle 2002b, Hamilton *et al.* 2005) and on occasion in the Mad River (Moyle *et. al*. 1995, Moyle 2002b), and Redwood Creek (Moyle *et. al*. 1995); however, historical abundance and abundance trends are difficult to quantify due to the lack of a long-term eulachon monitoring program in California. Information on the populations in northern California is dependent on direct observations by Yurok tribal members and local biologists. Spawning populations were last noticed by Yurok tribal members in the late 1980s. In 1996, the Yurok Tribal Fisheries Program attempted to sample eulachon run in the lower Klamath River using dip nets and electrofishing methods, totaling 110 hours of survey time between early February and early May. No eulachon were captured (Duran 2008). These observations mirror data for this species range-wide, indicating that the species has experienced a period of low abundance for more than 20 years (NMFS 2014c). While eulachon have declined substantially in the Klamath River, they have not been totally absent from this area in recent years. In particular, recent reports from Yurok Tribal Fisheries biologists of a few eulachon being caught incidentally in other fisheries on the Klamath in 2007 indicates eulachon still enter the Klamath River in low numbers (75 FR 13012). In the most recent status review, NMFS indicates that the Klamath River has seen a positive increase of adult eulachon presence in the 2011-2014 spawning seasons (NMFS 2016a).

Threats

Eulachon are affected by habitat loss due to hydroelectric dams that block access to historical eulachon spawning grounds, affect the quality of spawning substrates through flow management, and alter delivery of coarse sediments. Flows at spawning areas may also be affected by upstream water diversions (USACE 2010). Eulachon mortality is impacted by habitat degradation due to dredging, industrial and agricultural pollution, shoreline development, and forestry occurring at local scales and between spawning rivers. However, it is unlikely that such threats would explain the nearly synchronous coast-wide decline that has occurred (USACE 2010).

Eulachon have been shown to carry high levels of chemical pollutants. Although, it has not been demonstrated that high-contaminant loads in eulachon result in increased mortality or reduced reproductive success, such effects have been shown in other fish species (NMFS 2014c).

In addition to general threats to Southern DPS eulachon mentioned above, a qualitative ranking by the Eulachon Biological Review Team of the severity of threats for Klamath River eulachon are identified and listed as follows: climate change impacts on ocean conditions, dams/water diversion, eulachon bycatch, climate change impacts on freshwater habitat, predation, water quality, competition, catastrophic events, disease, shoreline construction, Tribal First/Nations Fisheries, nonnative species, and recreational harvest (Gustafson *et al*. 2010).

There is much uncertainty in our knowledge regarding how threats influence eulachon. There is actually more that is not known about the sDPS of eulachon than is known. These uncertainties present a challenge in developing quantifiable parameters (e.g., life-cycle models and population viability analysis) that would indicate when eulachon are viable, self-sufficient, and no longer in danger of extinction or likely to become endangered in the foreseeable future. As such, the Recovery Plan for the sDPS of eulachon (NMFS 2017) outlines multiple actions to address the knowledge gaps that we have. Some of these include developing a research, monitoring, evaluation, and adaptive management plan; establishing near-term research priorities; establishing a Eulachon Technical Recovery and Implementation Team; and implementing outreach and education strategies.

Critical Habitat and Physical or Biological Features for Eulachon Southern Distinct Population Segment

Critical habitat was designated for the Southern DPS eulachon on October 20, 2011 (76 FR 65324). In developing the critical habitat designation, NMFS developed a list of Physical Biological Features that are essential to the conservation of the Pacific eulachon, including: (1) freshwater spawning and incubation sites with water flow, quality, and temperature conditions, and substrate supporting spawning and incubation; and (2) freshwater and estuarine migration corridors free of obstruction, supporting larval and adult mobility, and with abundant prey items for larval stage. A comprehensive list of waterways designated as critical habitat for this DPS can be found in the Federal Register (76 FR 65324).

2.2.2.4 California Central Valley

2.2.2.4.1 Sacramento River Winter-run Chinook Salmon ESU Status

The Sacramento River winter-run Chinook salmon ESU, currently listed as endangered, was listed as a threatened species under emergency provisions of the Endangered Species Act (ESA) on August 4, 1989 (54 FR 32085), and was listed as a threatened species in a final rule on November 5, 1990 (55 FR 46515). On January 4, 1994, NMFS re-classified winter-run Chinook salmon as an endangered species (59 FR 440). NMFS concluded that winter-run Chinook salmon in the Sacramento River warranted listing as an endangered species due to several factors, including the following:

- The continued decline and increased variability of run sizes since its first listing as a threatened species in 1989
- The expectation of weak returns in future years as the result of two small year classes (1991 and 1993)
- Continued threats to winter-run Chinook salmon (59 FR 440; January 4, 1994)

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 (CDFG 2012). 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 (CDFG 2012). 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 (NMFS 2016h).

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 2016h). 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 2015). 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 in 2016 were a low, as they show the impact of 1,546 (CDFW 2017) due to drought impacts on juveniles from brood year 2013 (NMFS 2016g).

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 2011b). 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, but restoration is not scheduled to be completed until 2020. The Central Valley Salmon and Steelhead Recovery Plan (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 Central Valley Project (CVP) and State Water Project (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 (Reclamation 2008). Additionally, air temperature appears to be increasing at a greater rate than what was previously analyzed (Lindley *et. al*. 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 2014a).

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 2016h). Thus, large-scale fish passage and habitat restoration actions are necessary for improving the winter-run Chinook salmon ESU viability (NMFS 2016h).

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). 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). 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). 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 1997, Pacific States Marine FIsheries Commission 2014).

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.

2.2.2.4.2 Central Valley Spring-run Chinook Salmon Status

CV spring-run Chinook salmon were originally listed as threatened on September 16, 1999 (64 FR 50394). This ESU consists of naturally spawned spring-run Chinook salmon originating from the Sacramento River basin. The Feather River Fish Hatchery (FRFH) spring-run Chinook salmon population has been included as part of the CV spring-run Chinook salmon ESU in the most recent CV spring-run Chinook salmon listing decision (70 FR 37160; June 28, 2005). Although the FRFH spring-run Chinook salmon program is included in the ESU, the take prohibitions in 50 CFR 223.203 do not apply to these fish because they do not have an intact adipose-fin. Critical habitat was designated for CV spring-run Chinook salmon on September 2, 2005 (70 FR 52488).

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 1874), (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 2014). 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. 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).

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 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 2015).

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.* 2005a, Garza and Pearse 2008, Cavallo et al. 2009).

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 2011b), found that the biological status of the ESU had worsened since the status review in 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 2016h), 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 2016h).

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).

The NMFS Recovery Plan (2014), that includes CV spring-run Chinook salmon, CV winter-run salmon, and CV steelhead, identifies recovery goals that focus on addressing several key stressors that are vital to CV spring-run Chinook salmon. These include: (1) elevated water temperatures affecting adult migration and holding; (2) low flows and poor fish passage facilities, affecting attraction and migratory cues of migrating adults; and (3) possible catastrophic events (NMFS 2014).

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). The PBFs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine habitat. The geographical 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 FR 52488).

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.

2.2.2.4.3 California Central Valley Steelhead Status

CCV steelhead were originally listed as threatened on March 19, 1998 (63 FR 13347). Following a status review (Good et al. 2005) and after application of the agency's hatchery listing policy, NMFS reaffirmed the status of CCV steelhead as threatened and also listed the FRFH and Coleman NFH artificial propagation programs as part of the DPS on January 5, 2006 (71 FR 834). In doing so, NMFS applied the DPS policy to the species because the resident and anadromous life forms of steelhead remain "markedly separated" as a consequence of physical, ecological, and behavioral factors, and may therefore warrant delineation as separate DPSs (71 FR 834; January 5, 2006). On May 5, 2016, NMFS completed another 5-year status review of CCV steelhead and recommended that the CCV steelhead DPS remain classified as a threatened species (NMFS 2016c). Critical habitat was designated for CCV steelhead on September 2, 2005 (70 FR 52488).

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 2001b). By the early 1960s, the CCV steelhead run size had declined to about 40,000 adults (McEwan 2001b). 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. 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)). 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 2015).

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.* 2005b). 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. 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.* 2005a, NMFS 2016h). 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.* 2007b). 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 2002b).

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°F to 66°F (14°C to 19°C). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough *et al.* 2001). In fact, McCullough *et al.* (2001) recommended an optimal incubation temperature at or below 52°F to 55°F (11°C to 13°C). Successful smoltification in steelhead may be impaired by temperatures above 54°F (12°C), as reported in (Richter and Kolmes 2005). As stream temperatures warm due to climate change, the growth rates of juvenile steelhead could increase in some systems that are currently relatively cold, but potentially at the expense of decreased survival due to higher metabolic demands and greater presence and activity of predators. Stream temperatures that are currently marginal for spawning and rearing may become too warm to support wild steelhead populations.

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). The PBFs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine areas. The geographical 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.

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. Recovery efforts focus on addressing several key stressors that are vital to CV steelhead. These include: (1) elevated water temperatures affecting adult migration and holding; (2) low flows and poor fish passage facilities, affecting attraction and migratory cues of migrating adults; and (3) possible catastrophic events (NMFS 2014).

2.2.2.4.4 Southern Distinct Population Segment of North American Green Sturgeon Status

In June of 2001, NMFS received a petition to list green sturgeon and designate their critical habitat under the ESA. After completion of a status review (Adams et al. 2002), NMFS found that the species was comprised of two DPSs that qualify as species under the ESA, but that neither DPS warranted listing (68 FR 4433; January 29, 2003). Several entities challenged our determination that listing was not warranted in Federal district court, and the court issued an order setting aside and remanding our determination. Following a status review update in 2005, NMFS listed the sDPS as threatened based on the reduction of potential spawning habitat, the severe threats to the single remaining spawning population (in the Sacramento River), the inability to alleviate these threats with the conservation measures in place, and the decrease in observed numbers of juvenile green sturgeon collected in the past two decades before listing compared to those collected historically (71 FR 17757; April 7, 2006). Since the 2006 listing decision, new information has become available regarding the many threats to the species from entrainment, flow operations, reservoir operations, habitat loss, water quality, toxics, invasive species, and population dynamics, reaffirming NMFS' concerns that sDPS green sturgeon face substantial threats to their viability and recovery (Israel and Klimley 2008).

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 (Seesholtz *et al.* 2014, Israel *et al*. 2009a, Bergman *et al.* 2011). 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 Eenennaam 2012).

Recent research indicates that the sDPS is composed of a single, independent population, which principally spawns in the upper mainstem Sacramento River and also breeds opportunistically in the Feather River and possibly the Yuba River (Bergman *et al.* 2011, 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 2015c).

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 2017), and (2) by incidental catch of green sturgeon by the CDFW's white sturgeon sampling/tagging program (Dubois and Harris 2015, 2016). 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. As part of a doctoral thesis at the University of California at Davis (UC Davis), Ethan Mora has been using 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.* 2014).

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). 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 (Heublein *et al.* in review). 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 2015c). 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.

Critical Habitat and Physical or Biological Features for Southern Distinct Population Segment Green Sturgeon

The critical habitat designation for sDPS green sturgeon lists PBFs (74 FR 52300). 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 geographical range of designated critical habitat includes the following:

- In freshwater, the geographical 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 geographical 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 geographical 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.

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.

2.2.2.5 Climate Change

The best available scientific information indicates the accumulation of greenhouse gasses in the atmosphere is driving climate warming (IPCC 2007). The general physical effects of climate change include, but are not limited to: (1) sea level rise; (2) ocean acidification; (3) increased number of wildfires; (4) increases in water temperature in the ocean, rivers, and streams; (5) alterations in stream morphology, (6) increased droughts; and (7) modification of a variety of watershed processes such as run-off, erosion, and sedimentation. Coupled with naturally stressful conditions that occur during critical life stages, climate-related stressors are likely to affect the rangewide status of the species.

Environmental monitoring data in the southwestern United States indicate changes in climatic trends have the potential to affect species life history strategies and habitat requirements. The southwest U.S. average annual temperature is projected to rise approximately 4° F to 10° F over the region by the end of the century (USGRCP 2009). Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). Southern California is also experiencing an increasing trend in droughts, measured by the Palmer Drought Severity Index from 1958 to 2007 (USGRCP 2009). Snyder and Sloan (2005) project mean annual precipitation in central western California will decrease by about 3-percent by the end of the century. Statewide, climate models appear to make an average prediction of about 10 percent loss of precipitation by 2100 under a low emissions scenario (Cayan *et al*. 2008). Loss of precipitation may result in lower water flows and higher stream temperatures, which will negatively impact anadromous fish populations.

Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen *et al*. 2000). 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). The Sacramento River basin annual runoff amount for April- to July has been decreasing since about 1950 (Roos 1987, 1991). Increased temperatures influence the timing and magnitude patterns of the hydrograph, which may diminish snowmelt-dominated habitat that species such as stream-type Chinook may be dependent on.

The magnitude of snowpack reductions is subject to annual variability in precipitation and air temperature. The large spring snow water equivalent (SWE) percentage changes, late in the snow season, are due to a variety of factors including reduction in winter precipitation and temperature increases that rapidly melt spring snowpack (VanRheenen *et al.* 2004). Factors modeled by VanRheenen *et al*. (2004) show that the melt season shifts to earlier in the year, leading to a large percent reduction of spring SWE (up to 100 percent in shallow snowpack areas). Additionally, an air temperature increase of 3.8°F (2.1°C) is expected to result in a loss of about half of the average April snowpack storage (VanRheenen et al. 2004).

The 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 peak streamflow (temporal centroid of streamflow each year) change has recently amounted to 20 - 40 days at 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, ecosystems, 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.

Human alterations to the atmosphere and landscape can influence water temperature by changing factors that regulate stream temperature, such as discharge, stream morphology, groundwater interactions, riparian condition, and climatic drivers (Poole and Berman 2001). In the Pacific Northwest, summer stream temperatures saw an increase of approximately 0.22 °C/decade between 1980 and 2009 as a result of CO2 emissions (Isaak *et al.* 2012), and are projected to increase on average, +2.83 °C by the 2080s (Isaak *et al*. 2012). As stream temperatures change in response to land management and climate change, cold-water fishes such as Chinook Salmon (*O. tshawytscha*), steelhead (*O. mykiss*), and green sturgeon (*A. medirostris*) may be exposed to temperatures that are outside of their physiologic threshold, resulting in changes to fish communities and potential increased risk of extinction (Poole *et al*. 2001, Urban 2015).

In the marine environment, water is becoming more acidic due to the absorption of CO_2 from the atmosphere. Lower pH could be potentially detrimental to the food chains supporting juvenile salmon as recently observed along the west coast (Feely *et al*. 2008). Ocean acidification could hinder normal growth, development, and survival of young abalone by altering pH levels and the growth of crustose coralline algae (an important component of juvenile settlement habitat).

Additionally, elevated water temperatures could increase disease impacts on black abalone, alter the quantity and quality of food resources (macroalgae), and shift the distribution of black abalone northward if temperatures in the southern part of the range increase above the optimal range. Ocean-warming trends may also have severe consequences to eulachon, particularly in the southern portion of its range, where-ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success (Gustafson 2010).

In addition to ocean-warming and ocean acidification, sea levels are expected to rise. Sea level rise could alter the distribution and availability of rocky intertidal habitat for black abalone. Sea level rise could also impact juvenile fish in the San Francisco Bay and Delta, as well as in lagoons and estuaries as waters become more brackish and favor towards the marine environment.

The threat to listed species in this opinion 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 2007, Schneider 2007, Moser *et al.* 2012). Wildfires are expected to increase in frequency and magnitude (Westerling *et al.* 2011, Moser *et al.* 2012).

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

2.2.3 Essential Fish Habitat for Species with Potential to Occur in Action Area

Within the Action Area, EFH designations have been made for all estuarine and coastal waters of California as well as many inland watersheds that support salmon. The following FMPs designate EFH covered under this BO (Figures 4A and 4B):

- Pacific Coast Salmon FMP
- Coastal Pelagic Species FMP
- Pacific Coast Groundfish FMP
- Highly Migratory Species FMP

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).The action area for this BO consists of all the areas where the environmental effects of actions authorized by FEMA under this program may occur in California. This includes all upland, riparian, and aquatic areas affected by implementation of the Program. To determine which portions of California are within the action area, FEMA completed an analysis at the HU Code 8[11] watershed level, as defined by the U.S. Geological Survey, to identify watersheds and coastal boundaries within the State of California that have any one of the following characteristics:

- Are within the current or historic range of a federally listed anadromous fish or invertebrate species covered under the BO;
- Contain designated or proposed critical habitat for a federally listed anadromous fish or invertebrate species covered under the BO; or
- Contain areas designated as EFH under an approved FMP covered under the BO.

The action area corresponds to an overlay of the above three characteristics within all HU Code 8 watersheds in California. If a watershed contains at least one of the items listed above, it is included in the action area.

The action area, as defined through this process, is shown on Figure 1. Figure 2 shows the range of listed species under NMFS jurisdiction within the action area. Figure 3 shows the critical habitat of listed species under NMFS jurisdiction within the action area. Figures 4A and 4B show the extent of EFH within the action area. The action area includes the entirety of estuaries, waterways, and embayments along the Pacific coastline of California, as shown in Figure 2, including the waters and substrate between the high-tide line to 820 feet (250 meters) beyond the low-tide line. Within the watersheds identified in Figure 1 and 4A, the actual extent of critical habitat and EFH for Pacific Coast Salmon consists of certain waterways, substrate, and riparian zones as identified in the applicable critical habitat designations and FMP.

[11] The U.S. Geological Survey has identified each HU within the United States by a unique HU Code, consisting of two to eight digits based on the four levels of classification in the HU system. The first level of classification divides the Nation into 21 major geographic areas, or regions. The second level of classification divides the 21 regions into 221 subregions. The third level of classification subdivides many of the subregions into accounting units; these 378 hydrologic accounting units are nested within, or can be equivalent to the subregions. The fourth level of classification (or HU Code 8) is the cataloging unit, the smallest element in the hierarchy of HUs. There are 2,264 Cataloging Units in the Nation. Cataloging Units sometimes are called "watersheds."

Figure 2. The Action Area

Figure 3: Range of Listed Species under NMFS Jurisdiction Within the Action Area

Figure 4: Critical Habitat of Listed Species under NMFS Jurisdiction within the Action Area

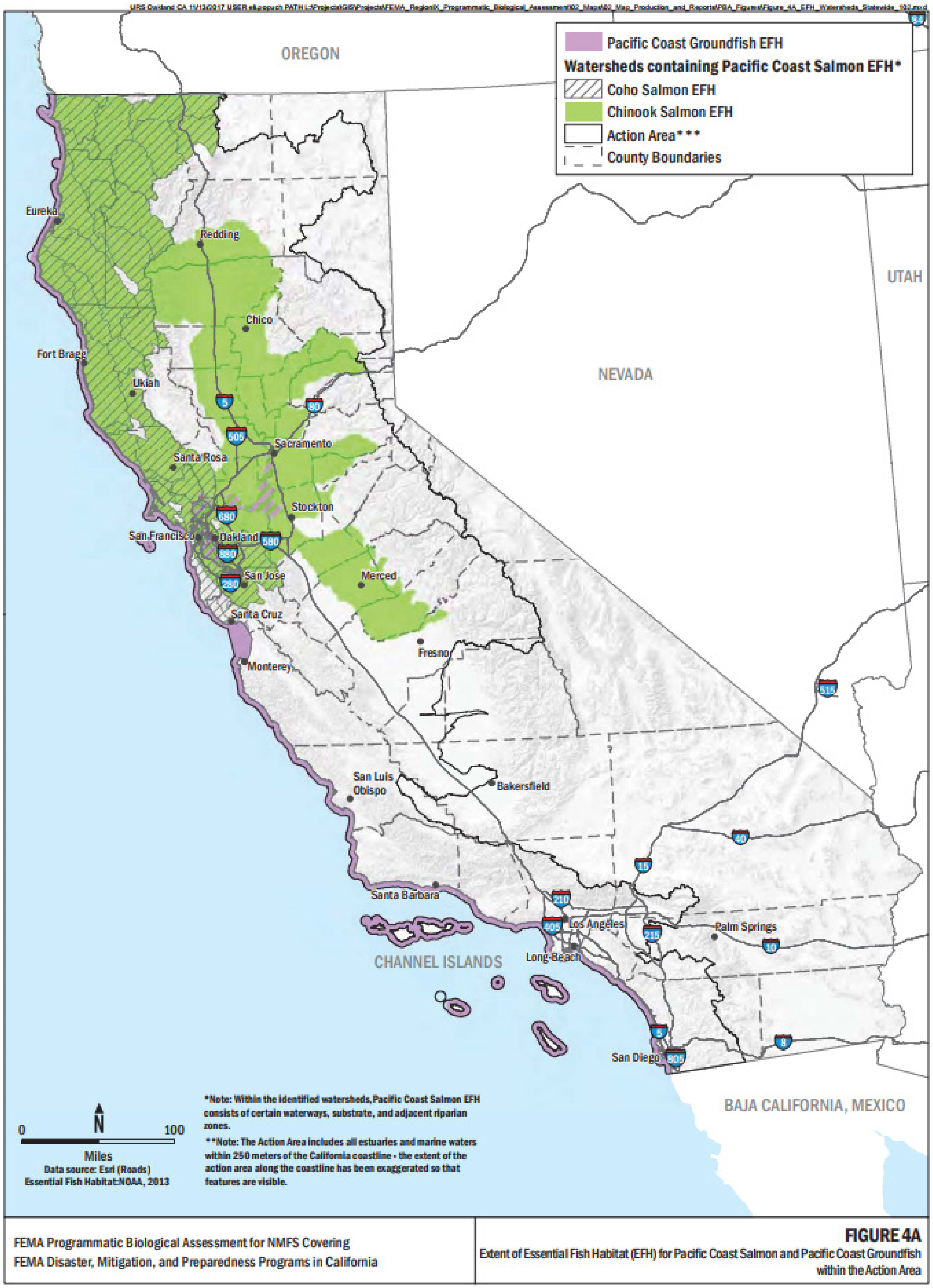

Figure 5. EFH Designation Within the Action Area

Figure 6. EFH Designation Within the Action Area

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 environmental baseline for this project extends throughout the large action area (see Section 2.3), throughout the state of California. To ascertain the action area with all past, present, and proposed actions, the action area has been divided into three areas: Southern California Coast, Central and Northern California Coast, and California's Central Valley. The environmental baseline has been further divided by types of actions affecting the natural environment.

2.4.1 Southern California

2.4.1.1 Urbanization

Urbanization has degraded anadromous salmonid habitat through stream channel realignment, flood plain drainage, and riparian damage (reviewed in 61 FR 56138). When watersheds are urbanized, problems may result simply because structures are placed in the path of natural runoff processes, or because the urbanization itself has induced changes in the hydrologic regime. In almost every point that urbanization activity touches the watershed, point source and nonpoint source pollution occurs.

Sources of nonpoint pollution, such as sediments washed from the urban areas, contain heavy metals such as copper, cadmium, zinc, and lead. These toxic substances, together with pesticides, herbicides, fertilizers, gasoline, and other petroleum products, contaminate drainage waters and harm aquatic life necessary for anadromous salmonid survival. Water infiltration is reduced due to extensive ground covering with impervious surfaces (*e.g.*, parking lots). As a result, runoff from the watershed is flashier, with increased flood hazard.

2.4.1.2 Flood-Control Activities

Streams within the action area have been altered over the past decades through activities that promote conveyance of flood waters. One activity has involved the removal of large and small woody debris (*e.g.*, live trees, downed tree trunks, limbs, root wads) from instream areas. Routine removal of riparian and instream vegetation has been reported to have a host of adverse consequences for stream-fish populations, including reductions in streamside and instream cover, increased stream temperature, streambank erosion and channel widening, lack of tree root structure creating undercut banks, reductions of live and fallen large woody debris within bankfull channel and reductions in fish abundance (Hicks *et al*. 1991, Thompson 2008, Platts *et al*. 1991). Thompson and others (2012) found that in southern California steelhead streams standing live and dead trees contributed a high proportion, 72 percent, of the total LWD loading within the bankfull width and were often key pieces in wood habitat features. Within the action area, removal of woody debris and vegetation from creeks is widespread, and occurs in numerous creeks each year that are designated critical habitat for steelhead (SBCFCD 2001, Questa 2003, SWCA 2010). Regional studies have identified that the extended summer low-flow period allows trees to become established within the bankfull channel that in turn provide critical habitat features utilized by steelhead (Thompson 2008, Thompson 2012). Given the value of instream woody debris to stream salmonids and the reported effects of woody-debris removal on stream habitats, the annual removal of live and dead stream vegetation has likely caused a reduction in the functional value of designated critical habitat for endangered and threatened steelhead, including a decrease in living- space capacity, and reduced abundance of juvenile steelhead in this portion of the action area.

Flood control and land drainage schemes may concentrate runoff, resulting in increased bank erosion that causes a loss of riparian vegetation and undercut banks and eventually causes widening and down-cutting of natural stream channels. The construction of concrete-lined channels, or channelization, is one flood-control method practitioners have utilized to protect urban infrastructure from concentrated storm runoff. Channelization and concrete-lined flood control channels exist throughout the action area and were constructed and are maintained to decrease roughness and maximize flood conveyance. Channelization of river channels can have numerous deleterious biological effects on waterways, including negative effects to essential features of instream habitat that are important to sustain growth and survival of stream fish (Brookes and Gregory 1988), and is principally responsible for the current character and condition of certain waterways in this portion of the action area.

2.4.1.3 Conversion of Wildland and Land Use

Within the SCCC steelhead action area, some coastal valleys and foothills are extensively developed with agriculture, principally row-crops, orchards, and vineyards. Several of the watersheds within the SCCC steelhead DPS (*e.g.*, Pajaro, Salinas, Santa Rosa, and Arroyo Grande) are developed for commercial agriculture, particularly row crops which are subjected to regular applications of a variety of pesticides (NMFS 2013). The nature and extent of the short and long-term effects of these pesticides on steelhead within the action area has not been extensively studied, and consequently is not well known. Agriculture developments within the Salinas River watershed, including livestock ranching and increasingly vineyards, are important land uses that directly or indirectly affect watershed processes throughout this DPS. A major consequence of agricultural activity in this region is reservoir development (NMFS 2013).

Within the SC steelhead action area, the conversion of wildlands for agriculture is perhaps most prevalent along coastal terraces, like the Santa Maria River Valley, which is intensively farmed. Managed flow releases from Twitchell Dam provide irrigation water to approximately 35,000 acres of cropland (USBR website). Seventy-five percent of the water supply from the Santa Maria River watershed goes to irrigation, watering crops such as sugar beets, strawberries, alfalfa, and, more recently, grapes (USBR 1996). Agricultural and urban development has severely constrained floodplain connectivity on sections of the Santa Maria River floodplain (SWCA 2011). Other areas in the SCC action area where agriculture is a significant land use activity include the Santa Ynez and Santa Clara River Valley in the south (NMFS 2012a).

Estuarine functions are adversely affected through a range of activities, including filling, diking, and draining. Approximately 75 percent of estuarine habitats across the SCCC steelhead DPS have been lost and the remaining 25 percent is constrained by agricultural and urban development, levees, and transportation corridors such as highways and railroads (NMFS 2013).

The SC steelhead DPS has been artificially reduced 70 to 95 percent by development (NMFS 2013). In addition to the loss of overall acreage, the habitat complexity and ecological functions of South-Central and Southern California estuaries have been substantially reduced as a result of: (a) loss of shallow-water habitats such as tidal channels, (b) degradation of water quality through both point and non-point waste discharges, and (c) artificial breaching of the seasonal sandbar at the estuaries mouth which can reduce and degrade steelhead rearing habitat by reducing water depths and the surface area of estuarine habitat.

2.4.1.4 Dams

Dams and diversions have a multitude of effects on fishery resources and quality of steelhead habitat (Blahm 1976, Mundie 1991, Smith 2000, NMFS 2013). Several drainages in San Luis Obispo County are completely blocked to steelhead migration owing to their respective dams, including the Nacimiento River (Nacimiento Reservoir Dam), Old Creek (Whale Rock Dam), West Corral De Piedra (Righetti Dam), Arroyo Grande Creek (Lopez Dam), Santa Maria River (Twitchell Dam), and Chorro Creek (Chorro Creek Dam) (NMFS 2013). All of these dams block steelhead from a substantial portion of the upper watersheds, which contain the majority of historical spawning and rearing habitats for anadromous *O. mykiss*. This habitat remain intact (though inaccessible to anadromous fish) and protected from intensive development as a result of their inclusion in the Los Padres National Forest (NMFS 2013).

Steelhead access to spawning and rearing habitat in the SC DPS action area has also been significantly reduced as a result of dam construction and continued operation on numerous steelhead drainages. The damming of the larger drainages including the Santa Ynez River (Gibraltar Dam and Bradbury Dam), Ventura River (Casitas Dam and Matilija Dam), Piru Creek (Santa Felicia Dam and Pyramid Dam) and Malibu Creek (Rindge Dam) blocks steelhead from historical spawning and rearing habitat because none of these reservoirs were constructed to allow fish passage. The amount of historical spawning and rearing habitat rendered unavailable to steelhead in these watersheds due to the construction of dams is substantial. As an example, the Santa Felicia Dam blocks 95 percent of the steelhead habitat within the Piru Creek watershed; more than 30 miles of stream lies between Santa Felicia Dam and Pyramid Dam alone (NMFS 2008a).

Remnant steelhead populations that reside upstream of dams have the potential to occasionally out- migrate downstream past these dams, but *O. mykiss* survival is expected to be low. The reason for the low expected survival is that steelhead smolts must migrate through large, static reservoirs and either pass over high-head dams via steep spillways or through the dam by circumventing the high velocity outlet works (*i.e.*, gates, energy dissipators). Operations of dams and diversions may decrease water available for surface flows, reducing rearing opportunities for steelhead and adversely affecting the physicochemical and biological characteristics of streams (Poff 1997).

2.4.1.5 Surface and Groundwater Withdrawals

In addition to blocking threatened and endangered steelhead from historical spawning and rearing habitats, the agricultural, municipal and private withdrawal of surface and groundwater from drainages in the action area, as well as characteristics of local geology, can lead to reach-specific instream dewatering primarily during the dry season and periods of below normal rainfall (NMFS 2012b, 2013). The artificial reduction in the amount and extent of surface flows can translate into decreased living space for steelhead, particularly over-summering juveniles and potentially death of this specific life stage (Spina 2006). Because freshwater rearing sites for over-summering steelhead are geographically limited throughout southern California, including the action area, the artificial reduction in freshwater rearing sites for juveniles during the summer can translate into a reduction in abundance of juvenile steelhead and, therefore, the number of returning adults in subsequent years.

Many larger screened diversions are installed on streams by constructing low-head dams that pond water and allow for stream diversion while providing some portion of discharge as a “bypass” flow for the intended purpose of providing sufficient fish migration flows. One such facility is the Robles Diversion Dam on the Ventura River, which is capable of diverting up to 500 cubic feet per second (cfs) discharge in a concrete channel, while the Casitas Municipal Water District maintains a minimum 50-cfs augmentation flow in the mainstem river for fish passage. Diversion dams can affect steelhead by causing migration delays and attenuating stream discharge that serves as a natural cue for migratory fish to emigrate in unregulated rivers, and affect habitat by disrupting the natural transport of spawning gravels and establishment of healthy riparian vegetation. Operation of unscreened diversions in this portion of the action area can disrupt migration of steelhead and prevent a large fraction of smolts from reaching the ocean due to entrainment of juveniles.

Groundwater withdrawals (primarily for irrigation) have reduced surface streamflow in many streams throughout California which has the functional effect of decreasing the amount and quality of steelhead rearing habitat. Water quantity problems are a significant cause of habitat degradation and depressed fish populations. Although some of the water withdrawn from streams eventually returns as agricultural runoff or groundwater recharge, crops consume a large proportion of it.

Water withdrawals have a significant effect on steelhead over-summer rearing habitat and seasonal flow patterns by removing water from streams when discharge is naturally modest (i.e., May through September). Over-summer rearing habitat has been found to be the most restricted habitat type in the SCCC and SC DPSs (Boughton and Goslin 2006).

2.4.1.6 Gravel Mining

Extraction of alluvial material from within or near a streambed has a direct impact on the stream’s physical habitat parameters such as channel hydraulics, morphology, sediment transport, bed elevation, and substrate composition (NMFS 2005b). Rivier (1985) suggests that the detrimental effects to biota resulting from bed-material mining are caused by two main processes: (1) alteration of the flow patterns resulting from modification of the river bed, and (2) an excess of suspended sediment.

The aggregate mining in the Santa Maria River and lower Sisquoc River since the early 1900's is expected to have caused a number of adverse effects on the quality and availability of habitat for endangered steelhead, given the reported effects of gravel mining on riverine environments (Kondolf 1997). Gravel mining can lead to overall physical degradation to the structure and function of river channels. In turn, a reduction in the physical and biological capability of the channel to support growth and survival of stream fish can be observed as well as an overall reduction in abundance.

Mining of sand and gravel occur in certain watersheds within San Luis Obispo County (*e.g.*, Salinas River, San Simeon Creek). Mining can contribute soil to streams, and cause sedimentation and turbidity, which can be harmful to fish (Cordone 1961, Hillman *et al*. 1987, Chapman 1988) and their habitat (Alexander 1986).

2.4.2 Central and Northern California

2.4.2.1 Timber Harvest

Timber harvest and associated activities occur over a large portion of the action area in the North Coastal range. 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 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).

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 period of time, we expect that fine sediment impacts will be similarly concentrated.

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.

2.4.2.2 Road Construction

Road construction, whether associated with timber harvest or other activities, has caused widespread impacts to salmonids (Furniss 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.

Construction of road networks can also greatly accelerate erosion rates within a watershed (Haupt 1959, Swanson and Dryness 1975, Swanston and Swanson 1976). 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 (Hagans and Weaver 1987). In the Mattole River watershed, 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 (Mattole Salmon Group 1997). 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.

2.4.2.3 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.

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 has also been found to lead to reduced growth of naturally produced fish (McMichael *et al.* 1997). Kostow (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 has also been shown to lead to density-dependent mechanisms that affect natural salmonid populations, especially during periods of poor ocean conditions (Beamish *et al*. 1997, 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 Hatcheryand Iron Gate Hatchery operate in the action area under NMFS approved Hatchery and Genetics Management Plans and have been identified as having potentially harmful effects to wild salmon populations. The Trinity Rivier Hatchery also operates in the action area and is currently undergoing a review process to reduce its adverse effects on the natual salmon population.

2.4.2.4 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.

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 migrational 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.* 2007b). Higher temperatures at these lower elevations during late-summer and fall are also a major stressor to adult and juvenile salmonids.

2.4.2.5 Predation

Predation was not believed to play 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), 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 2007a) 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.

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.

2.4.2.6 Disease

Disease has not been identified as a major factor in the decline of ESA-listed salmonids. 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. 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 (Shapovalov and Taft 1954). However, when this natural habitat is altered or degraded, outbreaks can occur. For example, ceratomyxosis, which is caused by *Ceratomyxa shasta*, has been identified as one of the most significant diseases for juvenile salmon in the Klamath Basin due to its prevalence and impacts there that are related to reduced flows and increased water temperatures (Nichols *et al.* 2007).

2.4.2.7 Fish Harvest

Salmon and steelhead once supported extensive tribal, commercial, and recreational fisheries. NMFS has identified over-utilization as a significant factor in their decline. This harvest strongly affected salmonid populations because, each year, it removed adult fish before they spawned, reducing the numbers of offspring in the next generation. In modern times, steelhead are rarely caught in ocean salmon fisheries. Directed ocean Chinook salmon fisheries are currently managed by NMFS to achieve Federal conservation goals for west coast salmon in the Pacific Coast Salmon Fishery Management Plan (FMP). The goals specify the numbers of adults that must be allowed to spawn annually, or maximum allowable adult harvest rates. In addition to the FMP goals, salmon fisheries must meet requirements developed through NMFS' intra-agency section 7 consultations, including limiting the incidental mortality rate of ESA-listed salmonids.

2.4.2.8 Agriculture

Many watersheds have been affected by agriculture, particularly throughout the central part of this area. Examples include the San Pablo Bay, Bodega Bay, Navarro River, and Gualala River watersheds. Historically, orchard, dairy and grazing were the dominant land use activities through many of these watersheds, though more recently, vineyards development has become increasingly popular. Napa, Sonoma, and Mendocino counties, for example, hosts an expanding population and wine industry.

A more recently recognized agricultural threat in the area is the illicit cultivation of marijuana. Many marijuana farms practice illegal, unregulated activities such as unregulated pesticide use, habitat destruction, and illegal damming and diversion of headwater streams for irrigating the illegal growing operations.

Past and present agricultural practices have resulted in numerous small dams and water diversions that alter streamflows and temperature conditions. Agricultural practices have likely contributed to depressed habitat conditions within waters such as the Navarro River watershed and Elkhorn Slough. The Pajaro River contains fecal coliform, nutrients, and sedimentation/siltation and is included on the 2012 Clean Water Act section 303(d) list of water quality limited segments (CSWRCB 2012). Suitable spawning and rearing habitat for S-CCC steelhead was once found on the mainstem Pajaro River, but now the mainstem functions solely as a migratory corridor because of impacts from flood control projects, agriculture, and water withdrawals for agricultural use.

2.4.2.9 Urbanization

Urban development is extensive within many portions the central part of the Northern California coast and has negatively affected the quality and quantity of ESA-listed species' habitat. Within the San Francisco Bay Area, human population 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.

2.4.3 California Central Valley

2.4.3.1 Dams

Dams are considered a major cause of the widespread decline of CV salmonids. Lindley *et al.* (2006) estimated that 80 percent of historically available steelhead habitat has been lost to impassable dams. On the Sacramento River, the construction of Keswick and Shasta dams in the 1940s blocked access to historical spawning and rearing habitat, which is no longer accessible to anadromous fish. Winter-run Chinook salmon have lost access to historical habitat in the Upper Sacramento River (upstream of Shasta Dam), the McCloud River, and the Pit River. This blockage merged at least three independent winter-run Chinook populations into a single population, resulting in a substantial loss of abundance, genetic diversity, life history variability, and local adaptation.

Hydroelectric power facilities, small dams, and operations caused habitat loss and degradation on Battle Creek, leading to the extirpation of winter-run Chinook salmon from that watershed in the early 1900s (Reynolds 1993). Watershed restoration actions associated with the Battle Creek Salmon and Steelhead Restoration Project are expected to restore conditions that will allow for successful reintroduction of a second population of winter-run to Battle Creek. A Fish Passage Team is currently discussing plans for a pilot reintroduction above Shasta Dam as part of the Reasonable and Prudent Alternative (RPA) actions of the 2009 NMFS biological opinion on the Long Term Operations of the CVP and SWP (NMFS 2009a).

The Redd Bluff Diversion Dam (RBDD) on the Sacramento River historically created impediments to fish passage by utilizing gates to divert water for agriculture and urban uses. RBDD has impaired passage to upstream migrating adults and out-migrating juveniles, and the dam's lighting system attracted predatory fish that were responsible for devouring many out-migrating juveniles. The gates have remained open since 2012, however, to allow passage for green sturgeon and anadromous individuals (USFWS 2014).

Before Friant Dam was completed in 1942 an estimated 50,000 CV spring-run Chinook migrated up the San Joaquin River (Fry 1961). The Friant Dam has caused about 60 miles (97 km) of the river to run dry, except in high water years when floodwaters are spilled from the dam. As a result, nearly the entire CVS Chinook run in the San Joaquin Basin was extirpated by the 1950s (Yoshiyama *et al.* 1998).

For more than 60 years, the mainstem San Joaquin River had been dry, but a settlement agreement in September 2006 sparked the implementation of the San Joaquin River Restoration Program (SJRRP) (a partnership between NMFS, USFWS, CDFW, water users, Reclamation, and other stakeholders). The SJRRP has secured flows from Friant Dam to provide access to spawning, rearing, and migration habitat for an experimental population of CVS Chinook that was reintroduced to the river under section 10(j) of the ESA. Since the reintroduction, "spring-running" adults have been documented migrating into the San Joaquin tributaries (Franks 2014).

It is likely that sDPS green sturgeon passage is blocked by impassible dams. sDPS green sturgeon have been observed at the base of impassable dams such as the Fish Barrier Dam (pers. comm. Alicia Seesholtz, DWR) on the Feather River and at Daguerre Point Dam on the Yuba River (Bergman *et al.* 2011), suggesting the possibility that adult green sturgeon would migrate further upstream, if possible.

Cold water releases from dams provide cool temperatures suitable for egg incubation, fry emergence, and juvenile rearing in the Sacramento River. However, warm water releases from Shasta Dam have been a significant stressor to all runs of salmon and steelhead in the Central Valley, especially given the recent extended drought in California in 2012-2015 (NMFS 2016c). In an effort to provide a continuous supply of cold water, a temperature control device (TCD) was installed on Shasta Dam in 1997. Although the TCD was built for the winter-run Chinook, it has also benefited other runs. Other efforts to reduce likelihood of warm water releases from Shasta Dam include improving reservoir meteorological and hydrologic modeling and monitoring, in order to most efficiently and effectively manage the reservoir's limited amount of cold water, and installation of additional temperature monitoring stations in the upper Sacramento River (NMFS 2016k).

Through the 2009 Biological Opinion on the long-term water operation 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 2016k).

2.4.3.2 Agriculture

The construction of the massive levee system in the Central Valley in the 19th and early 20th centuries to prevent flooding of agricultural fields was historically the biggest impact agriculture had on salmonids. Levee development in the Central Valley affects PBFs including: spawning habitat, freshwater rearing habitat, freshwater migration corridors, and estuarine habitat. Except in a few places such as Yolo and Sutter bybasses, levee building on the Sacramento River has prevented Chinook and steelhead juveniles from accessing these habitats.

Floodplains and backwater habitat are important for rearing juveniles. Sommer *et al*. (2001), Jeffres *et al.* (2008), and Katz *et al.* (2017) indicate significantly higher growth rates for juvenile Chinook rearing on floodplains as opposed to those rearing in riverine habitats. Hill and Webber (1999) found juvenile CVS Chinook rearing on the Sutter Bypass will likely emerge from that habitat nearly double their size at emigration from Butte, Mill, and Deer Creeks. This significant weight increase in the floodplain habitats is directly tied to increased survival at sea (Williams 2006).

Since the 1850s, wetlands reclamation for urban and agricultural development has caused the cumulative loss of 79 and 94 percent of the tidal marsh habitat in the Delta downstream and upstream of Chipps Island, respectively (Conomos *et al.* 1985, Nichols 1986, Phillips 1988, Monroe 1992, Goals Project 1999). Prior to 1850, approximately 1400 km^2 of freshwater marsh surrounded the confluence of the Sacramento and San Joaquin rivers, and another 800 km^2 of saltwater marsh fringed San Francisco Bay's margins. Of the original 2,200 km^2 of tidally influenced marsh, only about 125 km^2 of un-diked marsh remains today.

Water diversions are another component of agriculture that have adversely impacted ESA-listed fish species in the Central Valley. As much as 60 percent of the natural historical inflow to Central Valley watersheds and the Delta have been diverted for human uses. Agricultural diversions have caused direct and indirect harm by ways of entrainment, altering flow, and reducing water quality by causing higher water temperatures and increasing contaminants.

The CVP and SWP pumps in the southern Delta pull Sacramento River water to support agriculture in the southern Central Valley and provide water for the Bay area and southern California cities. Outmigrant juvenile salmonids in the Delta have been subjected to adverse environmental conditions created by water export operations at the CVP and SWP facilities. Specifically, juvenile salmonid survival has been reduced by the following: (1) water diversions from the main stem Sacramento River into the Central Delta via the Delta Cross Channel; (2) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; (3) entrainment at the CVP/SWP export facilities and extremely low survival in Clifton Court Forebay; and (4) increased exposure to introduced, non-native predators such as striped bass, largemouth bass (*Micropterus salmoides*), and smallmouth bass (*Micropterus dolomieu*).

NMFS issued a Biological Opinion on the impacts of the pumping procedures on salmon, sturgeon and killer whales that resulted in a jeopardy determination (NMFS 2009b). NMFS now partners with the USFWS, CDFW, the SWRCB, DWR, and others to ensure that water operations do not jeopardize the continued existence of winter-run Chinook.

2.4.3.3 Land use activities

Prior to the 1840's, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with bands of vegetation extending outward for 4 or 5 miles (California Resources Agency 1989). Starting in the California gold rush era, these vast riparian forests were cleared for building materials, fuel, and to clear land for farms. By 1979, riparian habitat along the Sacramento River diminished to 11,000 - 12,000 acres, or about 2 percent of historic levels (McGill and Price 1987). The clearing of the riparian forests removed a vital source of snags and driftwood (*i.e.,* LWM) in the Sacramento and San Joaquin River basins. This has reduced the volume of LWM, which is needed to form and maintain stream habitat that salmon depend on. In addition, removal of snags and obstructions from the active river channel for navigational safety has further reduced the presence of LWM in the Sacramento and San Joaquin rivers, as well as the Delta.

Prior to the 1970s, there was so much woody material resulting from poor logging practices that many streams were completely clogged and were thought to have been total barriers to fish migration. As a result, in the 1960s and early 1970s it was common practice among fishery management agencies to remove woody material thought to be a barrier to fish migration (NMFS 1996). However, it is now recognized that too much LWM was removed from the streams resulting in a loss of salmonid habitat and it is thought that the large scale removal of woody material prior to 1980 had major, long-term negative effects on rearing habitats for salmonids in northern California (NMFS 1996). Areas that were subjected to this removal of LWM are still limited in their ability to contribute to the recovery of salmonid stocks.

Reduction of wood in the stream channel, either from past or present activities, generally reduces pool quantity and quality, alters stream shading which can affect water temperature regimes and nutrient input, and can eliminate critical stream habitat needed for both vertebrate and invertebrate populations.

Past mining activities routinely resulted in the removal of spawning gravels from streams, the straightening and channelization of the stream corridor from dredging activities, and the leaching of toxic effluents into streams from mining operations. Many of the effects of past mining operations continue to impact salmonid habitat today. Current mining practices include suction dredging (sand and gravel mining), placer mining, lode mining and gravel mining. Present day mining practices are typically less intrusive than historic operations (hydraulic mining), however, adverse impacts to salmonid habitat still occur.

Dredging of river channels to enhance inland maritime trade and to provide raw material for levee construction has significantly altered the natural hydrology and function of the river systems in the Central Valley. Starting in the mid-1800s, the United States Army Corp of Engineers (Corps) and other private consortiums began straightening river channels and artificially deepening them to enhance shipping commerce. This has led to declines in the natural meandering of river channels and the formation of pool and riffle segments. The deepening of channels beyond their natural depth also has led to a significant alteration in the transport of bed load in the riverine system as well as the local flow velocity in the channel (Mount 1995). The creation of levees and the deep shipping channels reduced the natural tendency of the San Joaquin and Sacramento rivers to create floodplains along their banks with seasonal inundations during the wet winter season and the spring snow melt periods. These annual inundations provided necessary habitat for rearing and foraging of juvenile native fish that evolved with this flooding process.

2.4.3.4 Water Quality

The water quality of the Delta has been negatively impacted over the last 150 years. Increased water temperatures, decreased dissolved oxygen (DO) levels, and increased turbidity and contaminant loads have degraded the quality of the aquatic habitat for the rearing and migration of salmonids, Eulachon, and green sturgeon. Some common pollutants include effluent from wastewater treatment plants and chemical discharges such as dioxin from San Francisco Bay petroleum refineries (McEwan and Jackson 1996). In addition, agricultural drain water, another possible source of contaminants, can contribute up to 30 percent of the total inflow into the Sacramento River during the low-flow period of a dry year. The Regional Board, in its 1998 Clean Water Act §303(d) list characterized the Delta as an impaired waterbody having elevated levels of chlorpyrifos, dichlorodiphenyltrichlor (*i.e.* DDT), diazinon, electrical conductivity, Group A pesticides [aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexanes (including lindane), endosulfan and toxaphene], mercury, low DO, organic enrichment, and unknown toxicities (Regional Board 1998, 2001, 2010).

In general, water degradation or contamination can lead to either acute toxicity, resulting in death when concentrations are sufficiently elevated, or more typically, when concentrations are lower, to chronic or sublethal effects that reduce the physical health of the organism, and lessens its survival over an extended period of time. Mortality may become a secondary effect due to compromised physiology or behavioral changes that lessen the organism's ability to carry out its normal activities. For example, increased levels of heavy metals are detrimental to the health of an organism because they interfere with metabolic functions by inhibiting key enzyme activity in metabolic pathways, decrease neurological function, degrade cardiovascular output, and act as mutagens, teratogens or carcinogens in exposed organisms (Rand 1995, Goyer 1996). For listed species, these effects may occur directly to the listed fish or to its prey base, which reduces the forage base available to the listed species.

In the aquatic environment, most anthropogenic chemicals and waste materials, including toxic organic and inorganic chemicals that eventually accumulate in sediment (Ingersoll 1995). Direct exposure to contaminated sediments may cause deleterious effects to listed salmonids and green sturgeon. This may occur if a fish swims through a plume of the resuspended sediments or rests on contaminated substrate and absorbs the toxic compounds through one of several routes: dermal contact, ingestion, or uptake across the gills. Elevated contaminant levels may be found in localized “hot spots” where discharge occurs or where river currents deposit sediment loads.

Sediment contaminant levels can thus be significantly higher than the overlying water column concentrations (USEPA 1994). However, the more likely route of exposure to salmonids or green sturgeon is through the food chain, when the fish feed on organisms that are contaminated with toxic compounds. Prey species become contaminated either by feeding on the detritus associated with the sediments or dwelling in the sediment itself. Therefore, the degree of exposure to the salmonids and green sturgeon depends on their trophic level and the amount of contaminated forage base they consume. Response of salmonids and green sturgeon to contaminated sediments is similar to water borne exposures once the contaminant has entered the body of the fish.

2.4.3.5 Hatcheries

Six hatcheries currently produce Chinook salmon, and four produce steelhead in the Central Valley. Livingston-Stone National Fish Hatchery (LSNFH), located directly below Shasta Dam, is the only hatchery that produces winter-run Chinook salmon in the Central Valley. LSNFH produces on average 250,000 juveniles per year. Depending on the estimated return, only 90 to 120 returning adults are spawned per year.

LSNFH is a conservation hatchery with the objectives of monitoring and supplementing the naturally spawning population. Initially, the program was meant to jump start recovery of a very low population that was on the verge of extinction (*e.g.*, 186 spawners in 1994). However, since hatchery fish may negatively affect the genetic constitution of natural-origin fish (Hindar 1991, Allendorf 1997), LSNFH preferentially collects no more than 15 percent of the estimated winter-run Chinook salmon spawning escapement. Current estimates of the numerical contribution of the LSNFH hatchery program to the natural population are estimated between 5 and 20 percent (Lindley *et al.* 2007b), except in 2012, which was 30 percent. There is a concern that if the contribution of hatchery fish remains at the higher end of this range, potential impacts associated with genetic introgression are a risk.

CV spring-run Chinook salmon ESU includes fish naturally occurring in the Sacramento River and its tributaries, as well as those from the FRFH. The FRFH currently releases at least half of the spring-run Chinook salmon production into net pens in the San Francisco Bay. The management practices at FRFH has directly impacted spring-run Chinook salmon populations by oversaturating the natural carrying capacity of the limited habitat available below dams. In the case of the Feather River, significant redd superimposition occurs in-river due to hatchery overproduction and the inability to physically separate spring- and fall-run Chinook salmon adults. This concurrent spawning has led to hybridization between the spring- and fall-run Chinook salmon in the Feather River.

The Coleman National Fish Hatchery on the Sacramento River, the Feather River Hatchery, Mokelumne River Hatchery, and Nimbus Hatchery on the American River produce an average of 1.5 million juvenile CV steelhead per year (McEwan 2001a). Broodstock from outside the Central Valley have been used in all four hatcheries and have contributed to the elevated straying levels (U.S. Department of the Interior 1999).

The increase in Central Valley hatchery production has reversed the composition of the steelhead population, from 88 percent naturally produced fish in the 1950s (McEwan 2001a) to an estimated 23 to 37 percent naturally produced fish by 2000 (Nobriga and Cadrett 2001), and less than 10 percent currently (NMFS 2011a, c). The increase in hatchery steelhead production proportionate to the wild population has reduced the viability of the wild steelhead populations, increased the use of out-of-basin stocks for hatchery production, and increased straying (NMFS and CDFG 2001). Thus, the ability of natural populations to successfully reproduce and continue their genetic integrity has likely been diminished.

2.4.3.6 Fish Harvest

Extensive ocean recreational and commercial troll fisheries for Chinook salmon exist along the Northern and Central California coast, and an inland recreational fishery exists in the Central Valley for Chinook salmon and CV steelhead.

Winter-run Chinook salmon are primarily caught in the recreational fishery from Point Arena south to Monterey Bay (NMFS 2016j). Recent estimates for the years 2000-2013, excluding 2008-2010 when the fishery was closed, averaged 19% of the age-3 winter-run were taken annually by the ocean fishery (PFMC 2015). In 2012, the PFMC implemented specific control curves for winter-run Chinook salmon that reduced the level of ocean harvest depending on the annual population abundance (O'Farrell *et al.* 2012, Winship *et al*. 2013, PFMC 2013).

For CV spring-run, extensive ocean fisheries (both recreational and commercial) exist along the Central and Northern California coast up into Oregon. The in-river recreational fishery has historically taken CV spring-run throughout the species’ range within the Central Valley; however, regulations have been added. Specifically, closing CV spring-run spawning areas to fishing in Mill, Deer, Butte, and Big Chico creeks and the Yuba River. An extensive recreational fishery still occurs within the Feather River mainly due to the presence of the FRFH.

There is no ocean fishery for CV steelhead. However, there is an extensive freshwater recreational fishery. Hallock *et al*. (1961) estimated that harvest rates for Sacramento River steelhead from the 1953-1954 through 1958-1959 seasons ranged from 25.1–45.6 percent, assuming a 20 percent non-return rate of tags. The average annual harvest rate of adult steelhead above RBDD for the 3-year period from 1991-1992 through 1993-1994 was 16 percent (McEwan and Jackson 1996). Since 1998, all hatchery steelhead have been marked with an adipose fin clip allowing anglers to distinguish hatchery and wild steelhead. The freshwater fishery prohibits the harvest of naturally spawned steelhead within the Central Valley, and take is limited to one hatchery (marked) fish per day. Overall, the marking of hatchery steelhead has greatly increased protection of naturally produced steelhead; however, the total number of CV steelhead caught is likely a significant fraction of basin-wide escapement due to hooking mortality, and even low catch-and-release mortality may pose a problem for wild populations (Good *et al.* 2005a).

Within the San Francisco Estuary, green sturgeon are captured by sport fisherman targeting the more desirable white sturgeon, particularly in San Pablo and Suisun bays (Emmett *et al.* 1991). Green sturgeon are caught incidentally by sport fisherman targeting the more highly desired white sturgeon within the Delta waterways and the Sacramento River. All green sturgeon must be released unharmed and recorded on the sturgeon punch card by the angler.

Poaching rates of green sturgeon in the Central Valley are unknown; however, catches of sturgeon occur during all years, especially during wet years. Unfortunately, there is no catch, effort, and stock size data for this fishery, which precludes making exploitation estimates (USFWS 1995). Areas just downstream of Thermalito Afterbay outlet and Cox's Spillway, and several barriers impeding migration on the Feather River may be areas of high adult mortality from increased fishing effort and poaching. The small population of sturgeon inhabiting the San Joaquin River (believed to be currently composed of only white sturgeon) experiences heavy fishing pressure, particularly regarding illegal snagging and it may be more than the population can support (USFWS 1995).

In summary, the available information indicates that the level of winter-run Chinook harvest has remained the same, or declined since the status review in 2011 (NMFS 2011b) and that overutilization (harvest) is not likely to appreciably reduce winter-run abundance due to the regulatory actions that have been implemented since 2010 (*i.e.*, control curve rules). For CV spring-run, CV steelhead, and green sturgeon harvest is minimal due regulatory restrictions.

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.

This section describes the direct and indirect effects of the proposed action on all of the listed species and designated critical habitat addressed in this BO. Our presentation of the effects on the species generally pertains to both the threatened and endangered species; ESU/DPS-specific effects are distinguished only when necessary and appropriate. Coho salmon, Chinook salmon, and steelhead are all salmonid species and will experience the project effects described below in a similar way. Because of this, the effects analysis is focused on effects to salmonids in general with additional analysis provided for sturgeon, eulachon, and abalone as appropriate.

The potential for a proposed project to have an adverse effect on listed species, their critical habitats, and/or EFH depends on a variety of factors, including, but not limited to, the conditions present in the action area, the probability of species occurrence, timing of the activity, and the quality and quantity of the habitat within the project footprint and its vicinity. Because projects will occur in the future, and exact project descriptions needed to determine the precise effects of the proposed action on listed species and their habitats are limited or unavailable at this time, this assessment of effects is primarily qualitative, except where data are available. Given the scale of the action area and the nature of the activities, however, NMFS assumes the aggregate adverse effects described below will be low in intensity and severity. Our approach to assess effects is based on a review of ecological literature concerning the effects of loss and alteration of habitat elements important to anadromous fish and abalone, including water, substrate, food, and adjacent riparian areas, which are some of the PBF's of critical habitat that will be affected.

With regard to adverse effects on critical habitat, the proposed action is expected to affect certain PBFs, with the expected impacts for individual projects to vary from temporarily elevating turbidity concentration to temporarily dewatering discrete areas of streams. In this context, NMFS describes the effects to critical habitat and effects to the species. This section also evaluates the efficacy of the proposed avoidance and minimization measures.

NMFS expects that many of the effects of proposed action elements that will be covered programmatically (Framework Actions) would be similar to those effects analyzed below for Standard Actions. However, there may be Framework Actions with additional elements that are lacking sufficient information to analyze to the level of take at this time and are therefore not included in this summary of effects. Those activities are not expected to occur until further authorization and section 7 analysis is completed.

2.5.1 Effects to Species

The severity and intensity of the effects, in terms of changes in the condition of individual fish and abalone and the number of individuals affected, will vary somewhat between projects because of differences at each site in the scope of work area isolation and construction, the particular life history stages present, the baseline condition of each species present, and factors responsible for those conditions. We anticipate 106 or fewer projects will be completed in the NMFS' jurisditions of California, in a single year, as part of the proposed project (Table 3). The limits of coverage addressed in FEMA's Proposed Suitability Criteria (Section 1.3.7 and 1.3.8), limit project disturbance to 500 linear feet of stream bed or streambank or 0.5 acre of estuarine/marine waters. The intensity of those project effects is small when considered as a function of their average project footprint relative to the total streamside and/or estuarine/marine areas in California. Implementation of the program is expected to disturb up to 45,050 linear feet of streambed or streambank or up to 7.96 acres of estuarine/marine areas, partitioned between NMFS field office jurisdictions in a single year, within the action area.

The proximity of spawning adults, eggs, and fry of most salmon and steelhead species to any construction-related effects of projects completed under the proposed action that could injure or kill them will be limited by requiring work within the active channel to be isolated from that channel and completed in accordance with the attached guidelines for timing of in-water work (Appendix C) to protect fish and wildlife resources.

2.5.1.1 Erosion, Turbidity, and Sedimentation

All of the listed species addressed in this BO could potentially be affected by erosion, turbidity, and sedimentation; however, implementation of the avoidance and minimization measures in Section 1.3.9 would avoid or reduce these potential effects. Because the effects of short-lived fine-sediment releases from Program activities on critical habitat are somewhat uncertain, only a general characterization of the possible effects on listed species can be made. In general, increased erosion, turbidity, and sedimentation have the potential to adversely affect aquatic organisms in several ways, including reduced visibility of prey or forage items, respiratory stress, changes in temperature regimes, and in severe cases, damage to gills or other organs. During implementation of a proposed project, sediments may enter water bodies or become suspended in the water column through soil or substrate disturbances resulting from the use of heavy equipment, particularly during in-water work activities, such as the installation of temporary diversions or dewatering. This may include the deposition of construction-generated dust onto nearby waters and vegetation, and increased erosion and sedimentation during storm runoff resulting from terrestrial or riparian vegetation removal. These sediments may appear as localized increases in turbidity due to resuspension of fine sediments and may potentially result in burial of existing substrates when resuspended sediments settle. Turbidity increases may also occur when a water source reenters dewatered areas after the removal of work area isolation structures (e.g., cofferdams). Suspended sediment generated from pile driving or removal may also occur. The duration for the increased turbidity is dependent on several factors that include:

- The nature of vegetation, soils, and sediments in the action area;
- The flow or current velocities within the action area;
- The type of erosion-control structures installed at the action area;
- The amount of area that was originally disturbed and the local topography of the action area;
- The distance between the structure or activity and the water source, including the amount and type of filter materials (e.g., vegetation) in buffer areas; and
- The time duration and expected vegetation growth between the completion of the activity and onset of high flows or heavy rains.

Increases in erosion, turbidity, and sedimentation are likely to lead to under use of stream habitats, displacement from or avoidance of preferred rearing areas, or abandonment of preferred spawning grounds, which may increase losses to competition, disease, predation, or, for juvenile fish, reduce the ability to obtain food necessary for growth and maintenance (Moberg 2000;

Newcombe and Jensen 1996; Sprague and Drury 1969). However, the avoidance and minimization measures required of each project make it likely that fish would only vacate preferred areas temporarily and return quickly with negligible consequences to their fitness. Embryo development in salmonid redds downstream of construction sites is also expected to be impacted by fine-sediment releases. These short term effects are expected to occur in small localized areas for short durations of time, affecting a low proportion of individuals within the population. Adult and subadult green sturgeon are likely to be far less sensitive to suspended solids than salmonids. It is also reasonably certain that elevated suspended sediment concentrations will result in little to no behavioral and physical response due to the higher tolerance of green sturgeon, which usually inhabit much more turbid environments than do salmonids.

The use of the general construction avoidance and minimization measures described in Section 1.3.9 such as silt fences, sediment curtains, hay bales, and the dewatering of work areas would reduce the severity and duration of suspended sediment generated, and any remaining suspended sediment would resettle following the cessation of activities. In turn, these avoidance and minimization measures are expected to greatly reduce potential adverse effects to listed species, their prey, and their habitats downstream in a river or stream, or down current in a marine environment, of the activity. The avoidance and minimization measures would include seasonal work windows, restricting the entry of heavy equipment into waterbodies, and the establishment of upland staging areas for equipment and materials that would isolate sediment from waterbodies. Thus, the addition of fine sediment to streams and channels is expected to be minimal and cause short term, adverse behavioral effects to individual listed fish and abalone.

2.5.1.2 Potential Spills or Hazardous Materials

Potential spills or hazardous materials could potentially affect all of the listed species addressed in this consultation; however, implementation of the avoidance and minimization measures in Section 1.3.9 is expected to avoid or reduce this potential exposure. Chemical contamination of the water sources could occur from equipment leaks (e.g., diesel fuel, oil, hydraulic fluids, antifreeze), refueling spills, or an accidental spill during project implementation. Although proposed activities that occur in areas of known contamination are not covered under this BO, in-water work, such as pile-driving activities, sediment removal, and debris removal, may occur in areas of minor or unknown contamination, causing temporary decreases in local water quality. In the short term, removal of creosote or other piles treated with oil-based preservatives can release toxic preservatives into the surrounding water in the specific project area, resulting in a temporary degradation of water quality (Weston Solutions 2006). In the long term, removal of creosote piles will reduce water quality degradation.

Short-term effects of accidentally spilled hazardous material could include mortality of listed species, their prey, or plants that provide habitat if a high concentration of hazardous material causes suffocation or poisoning of listed species. Spilled hazardous materials could also injure listed species or their prey species without directly causing mortality through food web interactions. Long-term effects of spilled hazardous materials could include lingering elevated contaminant levels in soils and streambeds that could leach out and continue injuring or reducing reproductive success of listed species or their prey.

The implementation of avoidance and minimization measures would significantly reduce these hazards (Section 1.3.9). A Spill Prevention and Pollution Control Plan would be prepared to minimize the risk of spilled hazardous materials and other construction debris from entering soils and waterways. Equipment would be inspected daily for fuel leaks, any fuel leaks discovered would be immediately cleaned, wet cement and uncured concrete would not be allowed to enter waterways, stockpiled soils would be covered to prevent erosion, and all staging and hazardous material storage areas would be placed in upland areas that are paved, graveled, or otherwise non-erodible and away from water bodies. For proposed projects involving work over water, measures would be taken to ensure that construction debris is contained and does not fall into the water. Therefore, with the implementation of the proposed avoidance and minimization measures described above, potential spills or hazardous materials are not expected to cause adverse affects to individual listed fish or abalone species in the action area.

2.5.1.3 Noise and Sound Pressure

All of the listed fish species addressed in this BO could potentially be affected by activities creating noise and sound pressure. Pile driving, in-water drilling, cutting, or excavation can have adverse effects on the listed fish species by increasing in-water noise and vibration. Pile driving often generates intense sound pressure waves that can injure or kill fish (Reyff 2003, Abbott and Bing-Sawyer 2002, Caltrans 2001, Longmuir and Lively 2001, Stotz and Colby 2001). The type and size of the pile, the firmness of the substrate into which the pile is being driven, the depth of water, and the type and size of the pile-driving hammer all influence the sounds produced during pile driving. Fishes with swim bladders (including salmon and steelhead) are sensitive to underwater impulsive sounds, *i.e.*, sounds with a sharp sound pressure peak occurring in a short interval of time, (Caltrans 2001). As the pressure wave passes through a fish, the swim bladder is rapidly squeezed due to the high pressure, and then rapidly expanded as the under pressure component of the wave passes through the fish. The pneumatic pounding may rupture capillaries in the internal organs as indicated by observed blood in the abdominal cavity, and maceration of the kidney tissues (Caltrans 2001). The injuries caused by such pressure waves are known as barotraumas, and include hemorrhage and rupture of internal organs, as described above, and damage to the auditory system. Death can be instantaneous, can occur within minutes after exposure, or can occur several days later.

Fish respond differently to sounds produced by impact hammers than to sounds produced by vibratory hammers. Fish consistently avoid sounds like those of a vibratory hammer (Enger *et al.* 1993; Dolat 1997; Knudsen *et al.* 1997; Sand *et al.* 2000) and appear not to habituate to these sounds, even after repeated exposure (Dolat, 1997; Knudsen *et al.* 1997). On the other hand, fish may respond to the first few strikes of an impact hammer with a startle response, but then the startle response wanes and some fish remain within the potentially harmful area (Dolat 1997). Compared to impact hammers, vibratory hammers make sounds that have a longer duration (minutes vs. milliseconds) and have more energy in the lower frequencies (15-26 Hz vs. 100-800 Hz) (Würsig, *et al.* 2000).

A multi-agency work group identified criteria to define sound pressure levels where effects to fish are likely to occur from pile driving activities (Hydroacoustic Working Group, 2008). These thresholds, however, represent the initial onset of injury, and not the levels at which fish will be severely injured or killed. The most harmful level of effects is where a single strike generates peak noise levels greater than 206 dB_{peak}[12] where direct injury or death of fish can occur. Besides peak levels, sound exposure levels (SEL) (the amount of energy dose the fish receive) can also injure fish. These criteria are either 187 dB_{SEL} for fish larger than 2 grams or 183 dB_{SEL} for fish smaller than 2 grams for cumulative strikes (Hydroacoustic Working Group, 2008). In addition, any salmonid within a certain distance of the source (*i.e.* the radius where the root mean square (RMS) sound pressure level will exceed 150 dB_{RMS}) will be exposed to levels that change the fish's behavior or cause physical injury (*i.e.* harm). The result of exposure could be a temporary threshold shift in hearing due to fatigue of the auditory system, which can increase the risk of predation and reduce foraging or spawning success (Stadler and Woodbury, 2009). When these effects take place, they are likely to reduce the survival, growth, and reproduction of the affected fish. As black abalone lack a swim bladder and have other physiological differences from fish, underwater noise from pile driving is not expected to cause injury or behavioral effects to black abalone.

ESA-listed salmonids occur year-round in waters covered by this BO. The likelihood of injury or death, however, resulting from pile driving and removal will be minimized by completing the work during preferred in-water work windows, using a vibratory hammer where possible, using sound attenuators where an impact hammer is necessary, and limiting the number of strikes per day. Impact pile driving will result in sound increases greater than 150 dB that will degrade the fish passage within line of sight measured through water of the pile. Sound pressure levels generated from impact driving with a bubble curtain are expected to be below the instantaneous injury threshold of 206 dB_{peak}, thus there is little potential for an instantaneous injury from single strike peak pressure to juvenile or adult salmonids. Cumulative injury to salmonids is possible above 187 dB_{SEL} for salmonids weighing greater than 2 grams, and above 183 dB_{SEL} for salmonids weighing 2 grams or less.

FEMA anticipates a total of 25 pile driving projects may be funded over the life of this five-year programmatic consultation. For projects that result in adverse impacts to listed species as a result of underwater noise, we expect the effects would be limited to temporary threshold shifts to hearing and harassment or temporary behavioral changes. A small number of juveniles may exhibit a behavioral response that could lead to changes in movement or feeding, leading to increased predation and reduced fitness, survival, and growth. The impacts from these activities are not expected to result in a change at the population level.

2.5.1.4 Dewatering, Capture, and Relocation of Listed species

All of the listed fish species addressed in this BO could potentially be affected by activities requiring dewatering, capture and fish relocation. Most direct, lethal effects of authorizing and carrying out the proposed actions are likely to be caused by the isolation of in-water work areas, though lethal and sublethal effects would be greater without isolation. Any individual fish present in the work isolation area will be captured and released. Fish that are transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in traps, if the traps are not emptied on a regular

[12] dB_{peak} is referenced to 1 micropascal (re: 1µPa or one millionth of a pascal) throughout the rest of this document. A pascal is equal to 1 newton of force per square meter).

basis. The primary contributing factors to stress and death from handling are differences in water temperature between the river where the fish are captured and wherever the fish are held, dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma.

In many cases, dewatering, capture, and relocation reduces the magnitude of harm to listed species when compared to conducting in-water work without dewatering. The effects of dewatering and fish relocation would be minimized by following the avoidance and minimization measures as presented in Section 1.3.9. Capture and relocation would only be conducted by qualified biologists, using the most recent NMFS guidelines for fish or abalone relocation methods.

For proposed projects involving in-water work, dewatering may be necessary to properly install structures, reduce turbidity, and reduce the potential for direct injury to listed species. For projects where the diversion of continued stream flow is needed, conveyance by gravity through a temporary cofferdam and pipe system is the proposed preferred method, but pumps may be needed to move water in some instances. If pumps are used, the pump would be properly screened to prevent entrainment of listed fish species as described in Section 1.3.9. Temporary dewatering structures would be left in place for the minimum amount of time necessary for construction to allow fish to return to the habitat and/or continue migration. Dewatering of spawning habitat for listed species would not take place during spawning periods to avoid potentially exposing eggs and larvae to desiccation and dramatically reducing reproductive success.

Although FEMA proposes measures to minimize effects due to dewatering and fish relocation, we expect injury and mortality to a small number of juvenile salmonids, green sturgeon, and eulachon. McMicheal *et al.* (1998) estimates some injury or mortality of approximately 5 percent of relocated individuals, depending on conditions and the size of the fish affected. These fish would be lost from small localized areas within different watersheds throughout the action area and represent small proportions of the entire populations.

2.5.1.5 Effects on Fish Movement and Behavior

All of the listed fish species addressed in this BO could potentially be affected by projects that cause temporary effects on fish movements; however, implementation of the avoidance and minimization measures in Section 1.3.9 are expected to avoid or reduce these potential effects. These effects are generally not applicable to black abalone because this species does not make long-distance movements as part of its adult life cycle.

Rapid changes and extremes in environmental conditions caused by construction are likely to cause a physiological stress response that will change the behavior of salmon and steelhead (Moberg 2000; Shreck 2000). For example, reduced input of particulate organic matter to streams, the addition of fine sediment to channels, and mechanical disturbance of shallow-water habitats are likely to lead to under use of stream habitats, displacement from or avoidance of preferred rearing areas, or abandonment of preferred spawning grounds, which may increase losses to competition, disease, predation, or, for juvenile fish, reduce the ability to obtain food necessary for growth and maintenance (Moberg 2000; Newcombe and Jensen 1996; Sprague and Drury 1969).

In-water work has the potential to cause temporary disruptions in fish movement and behavior. Project-related underwater noise and disturbance resulting from in-channel work, as described in Section 2.5.1.4, may cause behavioral changes in listed fish species, such as dispersal or avoidance behavior, which could temporarily disrupt normal movements. Increases in turbidity and sedimentation due to project activities, as described in Section 2.5.1.1, could impair visibility and navigation, thereby affecting movement. Disturbance to or removal of stream habitat features (e.g., vegetation, large woody debris, boulders, gravel) could discourage fish from attempting to move through the disturbed stream section or increase the chance of predation during movement. If temporary dewatering of a channel is required, fish may avoid or be unable to make movements through bypass pipes or secondary channels. Projects that affect stream channel widths are also likely to impair local movements of juvenile fish for hours or days, and downstream migration may be similarly impaired. Fish may compensate for, and adapt to, some of these perturbing situations so that they continue to perform necessary physiological and behavioral functions, although in a diminished capacity. However, fish that are subject to prolonged, combined, or repeated stress by the effects of the action combined with poor environmental baseline conditions will likely suffer a metabolic cost that will be sufficient to impair their rearing, migrating, feeding, and sheltering behaviors and thereby increase the likelihood of injury or death.

While the extent of some of these project components, such as dewatering, are difficult to predict, such temporary, construction-related disruptions in fish movement and migration (including dewatering) are expected to be avoided or minimized by implementing the measures described in Section 1.3.9, which include deploying erosion control materials to prevent increases in turbidity, avoiding disturbance to stream habitat when possible, and working outside of fish migration windows.

As described in Sections 1.3.7, FEMA's Proposed Suitability Criteria does not cover proposed projects that would alter culverts and other water crossings in a manner that reduces the ability to pass migrating fish. A project may require work on existing fish passage barriers, which include total fish passage barriers, such as dams lacking fish passage structures and narrow, perched culverts that spill onto concrete aprons, as well as partial fish passage barriers, such as steep culverts, seasonal barriers, or impediments that slow, but do not necessarily prevent passage. As described in the proposed action, any project involving modifications to an existing fish passage barrier will include design features to improve fish passage around the barrier. Therefore, proposed projects covered under the BO are not expected to have permanent adverse effects on fish migration.

The small reduction in the growth and survival of fish, primarily juveniles, as a result of behavioral and movement changes is expected to be relatively low in intensity and severity thus, any adverse effects to fish growth and survival are likely to be inconsequential.

2.5.1.6 Invasive Species and Pathogens

Any of the listed species addressed in this BO could potentially be affected by invasive species and pathogens. In general, there is potential for invasive species or pathogens to be introduced to previously uninvaded areas during implementation of a proposed project.

During land-based construction, invasive species and pathogens are most typically introduced to an area when contaminated construction equipment is moved from a site containing the invasive species or pathogen to an uninvaded site. Seeds, propagules, and pathogens embedded in mud, soil, or other debris on construction equipment can fall into the soil or water of the uninvaded site. Invasive species and pathogens may also be transferred to an uninvaded site via construction materials or on the clothing or boots of those working at the site. During in-water work, invasive species and pathogens can be introduced to a water body if vessels are inadequately cleaned prior to transfer between invaded and uninvaded sites. Water-borne invasive species and pathogens are also commonly introduced via ballast or bilge water discharge. Plant pathogens may be introduced on construction equipment or on nursery plant material used in revegetation. Once introduced, invasive species can affect listed species through resource competition and predation. Pathogens can directly injure or kill listed species, or indirectly harm listed species by reducing prey abundance or detrimentally affecting aquatic and riparian vegetation.

The risk of spreading invasive species and pathogens is expected to be reduced by implementing avoidance and minimization measures as described in Section 1.3.9. Construction equipment, clothing, waders, and boots should be properly cleaned prior to moving between work sites, particularly if the prior work site is known to contain invasive species or pathogens. Discharge of ballast water will adhere to the U.S. Coast Guard's Standards for Living Organisms in Ships' Ballast Water Discharged in U.S. Waters (77 FR 17254). Therefore, the potential for introduction of invasive species and pathogens is not anticipated to occur and is not expected to result in adverseeffects to individual fish/abalone within the action area.

2.5.2 Effects to Critical Habitat

Projects covered by this BO, completed as proposed, including full application of the avoidance and minimization measures, are likely to have the following effects on critical habitat. These effects will vary somewhat in degree between actions because of differences in the scope of construction at each site, and in the current condition of PBFs and the factors responsible for those conditions.

We anticipate 106 or fewer projects will be completed in the NMFS' jurisditions of California, in a single year, as part of the proposed project (Table 3). The limits of coverage addressed in FEMA's Proposed Suitability Criteria (Section 1.3.7 and 1.3.8), limit project disturbance to 500 linear feet of stream bed or streambank or 0.5 acre of estuarine/marine waters. The intensity of those project effects is small when considered as a function of their average project footprint relative to the total streamside and/or estuarine/marine areas in California. Implementation of the program is expected to disturb up to 45,050 linear feet of streambed or streambank or up to 7.96 acres of estuarine/marine areas, partitioned between NMFS field office jurisdictions in a single year, within the action area.

Because the area affected for individual projects is small, the intensity and severity of the effects described is relatively low, and their frequency in a given watershed is very low, PBF conditions and conservation value of critical habitat at the site level or reach level are likely to quickly return to, and in some cases, improve beyond, critical habitat conditions that existed before the proposed action. This is because most actions are likely to partially or fully correct improper or inadequate engineering designs in ways that will help to restore habitat. Improved fish passage, in particular, may have long-term beneficial effects.

2.5.2.1 Riparian Habitat Removal and/or Degradation

For all the listed species addressed in this consultation, their respective designated critical habitat could potentially be affected by riparian habitat removal and/or degradation; however, implementation of the avoidance and minimization measures in Section 1.3.9 is expected to avoid or reduce these potential effects to habitat. In general, proposed projects may require modification to riparian vegetation within the footprint of repaired or modified facilities, vegetation management, water crossings, or other project areas. Some proposed projects may also require the trimming or removal or riparian vegetation for temporary access during construction. These modifications may be short-term (e.g., during construction only) or long-term.

The short-term removal of riparian vegetation may reduce prey availability and increase predation due to reduced cover. In addition, removal of vegetation, especially riparian shade trees, may remove thermal refugia and result in an incremental increase in water temperature. The long-term removal of riparian vegetation could result in reduced in-stream habitat quality and riparian habitat complexity, increased water temperatures, decreased trophic input from terrestrial sources, decreased floodwater and stormwater attenuation, and increased potential for erosion and sedimentation in the cleared riparian areas. Higher water temperatures can cause stress to anadromous fish and allow warm water fish species, which may compete with or prey upon salmonids, to establish residence (EPA 2001).

Furthermore, the removal of riparian vegetation can reduce the amount of large woody debris that enters into aquatic habitat. Large woody debris in the stream helps retain gravel for spawning habitat, create pools and habitat complexity, provide long-term nutrient storage and substrate for aquatic invertebrates that listed fish may prey upon, and provide refuge for fish and prey during high- and low-flow periods (Spence *et al.* 1996).

The likelihood and severity of these effects related to riparian habitat removal and/or degradation of designated critical habitat occurring is largely dependent on the quality and quantity and nature of riparian habitat affected. The potential for such effects occurring increases as the size of riparian habitat affected increases. As described in Avoidance and Minimization Measures (AMM-24), revegetation of stream and riverbanks would be required by FEMA when proposed projects remove riparian vegetation during construction activities. With the establishment of a 3:1 ratio replacement rate, riparian habitat in the action area is expected to return to pre-project conditions within a short time frame (approximately five years). This interim period of regrowth is expected to result in the short-term adverse effects described above to the rearing and migratory corridor PBFs of designated critical habitat.

2.5.2.2 Effects of Streambed, Bank, and Shoreline Modification

Designated critical habitat in freshwater and estuarine areas included in this BO could potentially be affected by changes caused by streambed, bank, and shoreline modification. However, implementation of the avoidance and minimization measures in Section 1.3.9 would avoid or reduce these potential effects. Streambed, bank, and shoreline modification can cause a decrease in infiltration, reducing stream flows during the summer by reducing the interception, storage, and release of ground water that affects habitat availability and productivity, particularly for those species that have extended freshwater rearing requirements (e.g., steelhead).

Many actions authorized or carried out under this opinion will seek to install rock or other hard structures within a functional floodplain to stabilize a streambank or channel and reduce erosion. The impacts of hardening the interactive floodplain include direct habitat loss, reduced water quality, upstream and downstream channel impacts, reduced ecological connectivity, and the risk of structural failure (Barnard *et al.* 2013; Cramer 2012; Fischenich 2003; NMFS 2011d; Schmetterling *et al.* 2001).

The addition of impervious surfaces within a watershed may also result in permanent effects to the habitat quality and hydrology of the stream or estuary. The expansion of impervious surfaces can increase both the volume of surface runoff and the peak rate of flow resulting from a storm event. The magnitude of stream discharge can strongly influence substrate and channel morphology. Increased peak runoff from impervious surfaces may cause stream bank erosion and channel scouring. Sediment from eroded and unstable stream banks may be deposited downstream, filling pools and altering substrate characteristics. The alteration in quantity and timing of surface run-off may also accelerate the downstream transport of wood. This results in simplified stream channels and greater instability, which reduces habitat value for fish (Spence *et al.* 1996). Similarly, the armoring of shorelines and stream banks and the deepening of channels may reduce overall habitat complexity, increase flow velocities, and affect stability of downstream banks.

Upstream and downstream channel effects occur when bank and channel hardening and channel narrowing alter stream velocity. Downstream, loss of stream roughness and channel narrowing causes water velocity and erosion to increase. Upstream, channel narrowing reduces water velocity and leads to backwater effects during high flows that typically result in upstream deposition (Lagasse, Schall and Richardson 2001). Then, when flows recede, erosion occurs around or through the new deposition. Thus, a hardened bank or channel creates chronically unstable conditions that increase bed and bank erosion upstream and downstream.

The effects caused by streambed, bank, and shoreline modification are expected to be avoided or minimized by implementing the measures described in Section 1.3.9. These measures include avoiding placement of roads, staging areas, and other facilities adjacent to streambank and stream channel habitat as much as possible and returning contours of the creek bed, vegetation, and creek flows to pre-construction condition or better after the completion of work. Designing projects to minimize the creation of new impervious surfaces and incorporating bioengineering and living shorelines techniques may also be used. Although measures to avoid and minimize will be implemented, adverse effects to the rearing and migratory corridor PBFs from bank repair projects are expected to occur, and only small, localized portions of critical habitat in the action area will have their value for conservation reduced.

2.5.2.3 Alteration of Shallow Water Critical Habitat

Designated critical habitat in riverine and estuarine areas could potentially be affected by permanent loss or alteration of shallow water habitat. However, implementation of the avoidance and minimization measures in Section 1.3.9 is expected to generally avoid or reduce potential effects to shallow water habitat. The spawning, rearing, and migratory corridor PBFs in both riverine and estuarine areas rely on sufficient shallow water habitat to provide adequate substrate for refuge, foraging, redd creation, and juvenile development. Riffles containing suitably sized gravel are important for salmonid spawning PBFs, and coastal shallow water habitat contains essential PBF's for all life stages of black abalone.

Proposed activities may include installing or expanding jetties, groins, breakwaters, and revetments to protect against high rates of erosion or wave activity. This may permanently reduce the amount of shallow water habitat available. Installation of rock or structures such as breakwaters, jetties, groins, and revetments can lead to habitat alterations such as, capturing large woody debris, reducing available rocky substrate for juvenile black abalone settlement, or otherwise inhibiting the movement of energy and material, and also reducing ecological connectivity by eliminating shallow water habitat.

The over-excavation of excess substrate from constructed channels, ditches, and stream and river channels in response to accumulation from disaster events deepens waters to below pre-disaster depths and eliminates shallow water habitat. This chronic source of bed removal is a major cause of channel instability and loss of sturgeon spawning and rearing habitat for long distances upstream and downstream, and is a source of mechanical disturbance in bays, estuaries, and lower elevation mainstem reaches where sturgeon occur. The limits of coverage established in the Suitability Criteria (Section 1.3.7), however, prohibit any new or maintenance dredging of channels, open water bays, or estuaries; although, projects that involve the removal of disaster-related sediment or debris from waterways may occur.

The creation or expansion of overwater and in-water structures, such as bridges and wharves, may create cover for predatory species and migration obstacles for juvenile and adult migrating listed fish species, which must expend additional energy to avoid these structures. In other cases, the removal of aquatic or overhanging vegetation may reduce cover and habitat complexity for listed fish species. Accumulation of woody debris in shallow waters can create hazardous conditions, such as after a flood event, necessitating the removal of material that otherwise contributes to complex habitat.

Dewatering of the isolated work areas may also alter shallow water critical habitat by drying out the substrate in that area, reducing the risk of exposure of streams to sediment and chemical contaminants resulting from construction activities. However, macro-invertebrates residing in the isolated work areas will die as the area dries out, resulting in temporarily reduced forage value for fish (Cushman 1985). Rapid recolonization, however, is expected after re-watering. Drift of food from upstream sources would be available immediately, thus the adverse effects of dewatering as a result of decreased food availability are expected to be limited to the period of the dewatering event. Isolation would occur during the summer approved in-water work period.

The limits of coverage established in this BO prevent large areas of shoreline or shallow waters from being altered in ways that would have substantial negative effects on listed species' designated critical habitat (see Section 1.3.7 and 1.3.8). Project designs to minimize the creation of new impervious surfaces and the agency recommended techniques on bioengineering and living shoreline techniques will also be used, as applicable. Adverse effects, however, to rearing, spawning, and migratory PBFs from alternations to shallow water habitat, as discussed above, are expected to occur in small, localized portions of critical habitat within the action area.

2.5.2.4 Permanent Loss or Alteration of Mid-Channel Critical Habitat

Mid-channel or deeper marine water portions of designated critical habitat could potentially be affected through permanent loss or alteration. However, implementation of the avoidance and minimization measures in Section 1.3.9 is expected to avoid or reduce these potential effects. Listed species may rely on sufficient mid-channel or deeper marine water habitat for migration, foraging, and refugia in riverine, estuarine, and marine areas. Similarly, mid-channel areas of rivers and streams are used as spawning areas where the substrate and hydrology are appropriate for fish species, such as green sturgeon and eulachon (Seesholtz et. al. 2014, NMFS 2010a).

The replacement or placement of culverts, bridge supports, or structures related to boat navigation may affect mid-channel habitat. The creation or expansion of in-water structures may create velocity refugia for predatory species and alter the movement of sediment in the channel. The removal of large woody debris, which may be necessary to repair unstable banks or remove debris that is causing flooding, may also reduce the complexity of mid-channel habitat. The placement of fill or changes to substrate type in marine waters up to 6 meters below mean lower-low water (76 FR 66806) may reduce the suitability of foraging, rearing, and spawning habitat for black abalone, particularly if areas of rock crevices are affected.

The limits of coverage established in FEMA's Proposed Suitability Criteria prevent large areas of mid-channel habitat (including spawning areas) from being altered in ways that have substantial negative effects on listed species' designated critical habitat (see Section 1.3.7). The proposed projects that do involve habitat alterations are expected to have short-term adverse effects on a small proportion of critical habitat within the action area.

2.5.2.5 Beneficial Effects to Critical Habitat

Proposed projects may have a variety of long-term beneficial effects to critical habitat PBFs, such as rearing, spawning, and migratory corridors. Beneficial effects may include stabilizing eroding banks, reducing sedimentation and turbidity in the water column, and replacing or removing structures that form partial or complete migration barriers with structures that improve fish passage or connectivity. Existing structures may also be modified or replaced in ways that provide shade and cover, reduce refugia for predators, replace hardened shorelines with living shoreline structures, improve hydrologic function of stream channels, or increase porosity of previously impervious surfaces. For example, overall beneficial effects would result from the replacement of an undersized, hanging culvert with an open bottom culvert as it would improve fish passage and allow better transport of substrate through the culvert. The guidelines on bioengineering and living shorelines techniques provide details on how projects may replace hardened waterway structures with structures that improve rearing and migratory corridor PBFs such as water quality, substrate, and natural cover of designated critical habitat for listed species.

2.5.3 Summary of Effects to Species and Critical Habitat

Table 3. Summary of effects to species and critical habitat.

Anticpated Effect/Impact	Program Activity	Duration of Impact	Severity of Impact	Rationale for Anticipated Effect/Impact	Habitat Response	Salmonid Response	Green Sturgeon Response	Black Abalone Response
Erosion, Turbidity, and Sedimentation	1, 2, 3, 4	Temporary, duration of activity	Moderate	Exposed soil, increased potential for sedimentation	Fine sediment fouling & rearing sites	Migration, avoidance, impaired embryo development & impaired juvenile feeding	Migration avoidance	Reduced larval settlement
Potential spills or hazardous materials	1, 2, 3, 4	Temporary	Low	Exposed contaminated sediment, equipment leaks or accidental spills	Temporary reduction in habitat quality	Avoidance, unsuccessful reproduction, impaired embryo development	Avoidance, unsuccessful reproduction, impaired embryo development	
Noise and sound pressure	2, 3	Temporary, duration of activity	Low-High	Pile driving, in-water drilling, cutting, or excavating	Temporary increase in in-water noise	Avoidance, barotrauma, or possible death	Avoidance, barotrauma, or possible death	
Dewatering, capture and relocation of fish	2, 3	Low flow season	Moderate-High	Reduce the potential for direct injury to federally listed fish species	Reduction in habitat quantity & quality	Avoidance, handling stress, possible death	Avoidance, handling stress, possible death	Not likely to impact
Temporary or permanent effects on migration or fish movement	1, 2, 3, 4	Temporary or permanent	Low	Temporary barriers may be installed during construction. Any permanent effects to fish movement must be beneficial/facilitate migration	Reduction in ability for fish to access habitat	Temporary barriers to fish movement during construction; long-term benefits to migration corridors	Temporary barriers to fish movement during construction; long-term benefits to migration corridors	NA
Riparian habitat removal and/or degradation	1, 2, 3, 4	Temporary loss. Removed vegetation would be replaced at a 3:1 ratio with an 80 percent planting survival 5 years after planting	Low	Access routes & heavy equipment	Loss of stream shading & thermal refugia, increased erosion and sedimentation	Heat stress, redistribution, decreased quality spawning & rearing habitat, decreased foraging opportunities	Heat stress, redistribution, decreased quality spawning & rearing habitat,	Not likely to impact
Streambed, bank, and shoreline m odification	2, 3	Continuous	Moderate	Shoreline armoring and expansion of impervious surfaces	Bank failure, loss or habitat access, poor water quality, alteration to PCEs	Redistribution, restricted seasonal movements, decreased quality spawning habitat, stranding, heat stress	Loss of quality spawning, rearing, foraging, and migration habitat; stranding; heat stress	Not likely to impact

Anticpated Effect/Impact	Program Activity	Duration of Impact	Severity of Impact	Rationale for Anticipated Effect/Impact	Habitat Response	Salmonid Response	Green Sturgeon Response	Black Abalone Response
Invasive species and pathogens	1, 2, 3, 4	Permanent	Low	Personnel and equipment bringing invasive species and pathogens into contact with listed species and/or critical habitat	Invasive species and pathogens can exceed habitat sustainability threshold and degrade habitat quality for listed species	Death or injury to species from direct contact with invasives or pathogens, or indirectly due to habitat degradation	Death or injury to species from direct contact with invasives or pathogens, or indirectly due to habitat degradation	Death or injury to species from direct contact with invasives or pathogens, or indirectly due to habitat degradation
Loss or alteration of shallow water habitat	1, 2, 3	Temporary - permanent	Moderate	Bank stabilization activities could remove shallow water habitat, Creation or expansion of in-water structures	Reduction in refuge, foraging, spawning, rearing habitat for listed fish species	Increased risk of predation; decrease in quantity and quality of spawning, rearing, and foraging habitat; increased water temperatures; Reduction in feeding opportunities	Increased risk of predation; decrease in quantity and quality of spawning, rearing, and foraging habitat; increased water temperatures; Reduction in feeding opportunities	Reduced larval recruitment and settlement
Loss or alteration of mid-channel habitat	1, 2, 3	Temporary - permanent	Moderate	Creation or expansion of in-water structures	Reduction in habitat for mitigation, foraging, refugia, and spawning areas	Increased risk of predation; decrease in habitat quantity and quality for spawning, rearing, refugia, foraging, and migration	Reduced availability of foraging substrate; decrease in habitat quantity and quality for refugia, migration, spawning, and rearing	

Key to Program activities are as follows:
1 = Non-Emergency Debris Removal;
2 = Constructing, modifying, or Relocating Facilities;
3 = Actions Involving Watercourses and Coastal Features; and
4 = Wildfire Risk Reduction.

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.

The most common future State, tribal, local, or private activities reasonably certain to continue to occur in the Action Area are agricultural activities, residential/urban development, recreational activities, timber harvest, road construction and maintenance, gravel/rock/metals mining, commercial fishing, and infrastructure development, which are described in the environmental baseline (Section 2.4). The NMFS assumes that future private, State, and tribal actions will continue increasing within the action area as the population rises.

Urban development will likely increase the amount of impervious surfaces within some of the watersheds, which is expected to raise the potential for dry and wet season run off and input of potentially toxic elements in anadromous streams. Flood control activities may reduce riparian vegetation, alter stream hydraulics and geomorphology, and impede successful migration. Increased urbanization is expected to cause elevated rates of treated wastewater releases to streams which can increase nitrogen loads and result in adverse effects on aquatic organisms. Residential growth on or along floodplains of rivers is expected to disrupt fluvial processes resulting in the loss of instream habitat and riparian vegetation. Agricultural development is expected to increase runoff and water usage which may increase the input of fertilizers, herbicides, and pesticides into streams. New surface and groundwater withdrawals in the action area are expected to translate into decreased living space for anadromous fish. Ongoing mining activities will likely modify stream channel geomorphology and increase runoff of fine sediments into streams. Coastal development will likely contribute to coastal erosion and loss of viable habitat for black abalone.

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

Based on the wide geographic scope and the duration of the proposed action, future State, tribal, local, or private activities that could cumulatively affect the federally listed species covered in this BO are expected to occur statewide, however, it is not possible to predict the future intensity of specific non-Federal actions at this program scale.

2.7 Integration and Synthesis

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

2.7.1 Synthesis of the Analysis on Listed Species Populations and Critical Habitat

The action area for this program extends throughout the entire state of California, and contains the following listed species: green sturgeon, coho salmon, steelhead, Chinook salmon, euchalon, and black abalone. As described in the Status of the Species (Section 2.2), populations of the above listed species have all experienced significant declines in abundance and available habitat in California, relative to historical conditions. The current status of listed species within the action area, based on their risk of extinction, has not significantly improved since their listing (see Section 2.2), and the severe decline in populations of listed species, coupled with the degraded environmental baseline (Section 2.4), demonstrates the need for actions that will assist the recovery of all ESA-listed species in the action area. According to the most recently released status review for listed salmonids, most salmonid species in the action area have experienced little to no change in extinction risk since the previous status reviews, but climatic conditions in California in recent years have increasingly contributed to negative impacts encountered by such species. Climatic conditions in the past few years have caused exceptionally high air, stream, and upper-ocean temperatures, which have all had negative effects on all freshwater, estuary, and marine phases for many populations of Chinook salmon, coho salmon, and steelhead (Williams *et al*. 2016). If actions are not taken to reverse current trends, the listed species in the program action area will continue to be at risk. As described in the analysis of the effects of the action (Section 2.5), the effects of the proposed action will cause only short-term, localized, and minor effects to listed species populations in the action area.

Currently, accessible aquatic habitat throughout the action area has been severely degraded, and the condition of PBFs of designated critical habitats, specifically their ability to provide for long-term conservation, has also been degraded from conditions known to support viable populations. Coastal development has contributed to coastal erosion and loss of viable habitat for black abalone, and intensive land and stream manipulation during the past century has modified and eliminated much of the historic anadromous habitat in California. Logging throughout central and northern California 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 habitat has been removed, reducing future sources of LWD. Agriculture in the Central Valley degraded valuable habitat through the construction of the massive levee system in the 19th an early 20th centuries. The proliferation of urban areas within many of the coastal watersheds throughout southern California has caused reductions in the quality of critical habitat and abundance of desirable aquatic species, and increased eutrophication of receiving waters such as estuaries and streams (Weaver and Garman 1994, Bowen and Valiela 2001, Quist *et al.* 2003). Today, these problems are further exacerbated by climatic conditions, including below average precipitation, high surface air temperatures and low snowpack. While historically salmonids have been able to adapt to changing climatic conditions, their ability to do so now is quite limited due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation (Williams *et al*. 2016). Cumulative effects (described in Section 2.6) are likely to add to these effects on salmon, steelhead, eulachon, green sturgeon, and black abalone population abundance, productivity, and spatial structure.

This program involves work in critical habitat for listed species of green sturgeon, coho salmon, steelhead, Chinook salmon, euchalon, and black abalone, which is expected to contribute to the degraded habitat of each species. Implementation of the program is expected to disturb up to 45,050 linear feet of streambed or streambank or up to 8.56 acres of estuarine/marine areas, partitioned between NMFS field office jurisdictions in a single year, within the action area, potentially affecting all listed species and their critical habitat. Implementation of these projects in areas occupied by these listed species have the potential to subject the species to an elevated exposure risk for a range of direct and indirect effects depending on the program activity, described in section 2.5. Proposed avoidance and minimization measures, however, within the program are expected to significantly reduce the potential risk and/or degree of impact for many of these effects.

Adverse effects to species and their critical habitat are expected in the form of short-term behavioral changes with a minimal amount of mortality. Increases in erosion, turbidity, and sedimentation are expected to lead to under temporary displacement from or avoidance of preferred rearing areas. The release of fine sediment from construction related activities is expected to cause adult fish to temporarily avoid spawning in those areas and short-term effects to juvenile feeding behavior. Also, embryo development in salmonid redds downstream of construction sites is expected to be impacted by fine-sediment releases. Construction within instream and channel habitat is expected to create barriers to fish passage that restrict seasonal movement or result in loss of aquatic habitat. Underwater noise activities is expected to result in harassment or cause temporary behavior modification, resulting in reduced fitness, survival, and growth. Riparian habitat removal is expected to reduce prey availability, increase predation due to reduced cover, and reduce thermal refugia. Changes in hydrology caused by streambed, bank, and shoreline modification is expected to change channel morphology, alter flow velocities, and affect stability of downstream banks. FEMA's proposed avoidance and minimization measures, however, are expected to significantly reduce the potential risk and/or degree of impact for many of these effects, such that there is a low probability of exposure, to a low proportion of individuals within a population.

The highest expected exposure to direct effects is for those projects that involve dewatering of the stream channel and would require the capture and relocation of stranded fish from these areas, which may result in injury or death. A few stranded individuals may not be relocated in time and will likely become mortalities. Overall, these fish would be lost from small localized areas within different watersheds throughout the action area and represent a small proportion of the entire population. Therefore, it is unlikely that the low level mortality of individual fish that NMFS anticipates from relocation activities, stranding, and reduced egg survival, will result in a change to the viability of a particular population.

Generally, projects authorized through this consultation are expected to be designed and implemented consistent with standard techniques and avoidance and minimization measures of the proposed project, including NMFS' fish passage and screening guidelines, which is expected to greatly minimize adverse effects on the listed species and their critical habitats. No project will have effects on the listed species that are beyond the full range of effects described. The effects of some of the proposed action are also reasonably certain to result in some degree of ecological recovery due to the requirements for bioengineered bank treatments and fish passage where it may have been partial or nonexistent before.

Effects of interrelated and interdependent actions that are reasonably certain to occur include the continued operation and maintenance of structures and facilities included in the proposed action.

The operation and maintenance activities and level of effects will vary with the type and purpose of the structure or activity completed. The specific effects from these activities is difficult to identify within the context of this mixed-framework programmatic consultation. The requirement for NMFS review of each project will allow for site specific evaluation as to the appropriateness of the activity as it affects listed fish and abalone, and their habitats.

The programmatic nature of the action prevents a precise analysis of each action that eventually will be funded or carried out under this BO, although each type of action must be carried out following the carefully designed suitability criteria and avoidance and minimization measures. The application of the AMMs to each action then, ensures that environmental outcomes of each activity can be readily predicted in a manner than enables a comprehensive synthesis of the effects of carrying out the program across the action area. As described the analysis of effects of the action (Section 2.5), the effects of the proposed activities will cause only short-term, localized, and minor effects

2.7.2 Discussion of Effects at the ESU/DPS Level

In this section we discuss and analyze the above described effects at the ESU/DPS level.

2.7.2.1 Coho salmon (Oncorhynchus kisutch)

Coho salmon populations throughout the action area have shown a dramatic decrease in both numbers and distribution; SONCC coho salmon and CCC coho salmon do not occupy many of the streams where they occurred historically. Although SONCC coho salmon within the action area are relatively more abundant and better distributed than CCC coho salmon, both the presence-absence and trend data available suggest that many SONCC coho salmon populations in the larger basins (*e.g.*, Eel and Klamath) continue to decline. Available information suggests that CCC coho salmon abundance is very low, the ESU is not able to produce enough offspring to maintain itself (population growth rates are negative), and populations have experienced range constriction, fragmentation, and a loss in genetic diversity. Many subpopulations that may have acted to support the species' overall numbers and geographic distribution have likely been extirpated (*i.e.* San Francisco Bay Area, Napa HUCs). 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 and CCC 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, and CCC coho salmon are presently in danger of extinction, therefore the likelihood of both survival and recovery are reduced compared to an ESU at low risk of extinction.

The adverse effects to CCC coho salmon and SONCC coho salmon within the action area are not expected to affect the overall survival and recovery of the ESUs. Adverse effects to individuals and habitat include actions that are expected to cause temporary and permanent habitat degradation or removal; increased sedimentation and turbidity; dewatering, capture, and relocation; and hydraulic effects (Section 2.5). The implementation of avoidance and minimization measures, however, would significantly reduce direct and indirect adverse effects of those activities (Section 1.3.9). These actions are expected to result in adverse effects to a small number of individuals, and small portions of localized habitat, leading to migration delays, injury or death, and harm. These adverse effects are expected to affect a very small proportion of the ESUs.

2.7.2.2 Steelhead (Oncorhynchus mykiss)

Although NC steelhead, CCC steelhead, CV steelhead, SCC steelhead, 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 coho salmon ESUs. 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, CCC steelhead, CV steelhead SCC steelhead, and S-CCC steelhead.

Recent updated status reports indicate that chief causes for the numerical decline of steelhead in southern California include urbanization, water withdrawals, channelization of creeks, human-made barriers to migration, and the introduction of exotic fishes and riparian plants (Good et al. 2005, Williams et al. 2011c; NMFS 2016b). The factors most generally attributed with causing NC DPS steelhead decline include: land use activities associated with logging, road construction, urban development, gravel mining, agriculture, ranching, and recreation. These activities all result in the loss, degradation, simplification, and fragmentation of available habitat for the DPS. Central Valley steelhead face many similar threats to SCCC steelhead, SCC steelhead, CCC steelhead and NC steelhead including loss of freshwater spawning and rearing habitat, loss of estuarine habitat, and degraded watershed processes. This program includes actions that could worsen the greatest threats facing these DPSs, such as construction actions that require riparian habitat removal and altering stream bank or river channel morphology (and further described in the analysis of the effects of the action Section 2.5). The adverse effects of the proposed activities are expected to affect small portions or localized habitat and individuals, leading to migration delays, injury or death, and harm. The implementation of avoidance and minimization measures, however, would significantly reduce direct and indirect adverse effects of those activities (Section 1.3.9).

2.7.2.3 Chinook salmon (Oncorhynchus tshawytscha)

The most recent status review for CV spring-run Chinook, CC Chinook, and SR winter-run Chinook found continued evidence of low population sizes relative to historical abundance. The status review for SR winter-run Chinook salmon ESU demonstrated that the ESU has further declined, and that continued loss of historical habitat and the degradation of remaining habitat continue to be major threats to the SR winter-run Chinook salmon ESU (NMFS 2016e). Sacramento River winter-run Chinook are at high risk of extinction.

In the 2016 status review, NMFS found, with a few exceptions, that CV spring-run Chinook salmon populations have increased through 2014 returns since the last status review (2011), which moved the Mill and Deer creek populations from the high extinction risk category to moderate, and Butte Creek remaining in the low risk of extinction category. Additionally, the Battle Creek and Clear Creek populations continued to show stable or increasing numbers in that period, putting them at moderate risk of extinction based on abundance.

For CC Chinook salmon, the status review demonstrated mixed abundance trends within some larger watersheds of northern California which may suggest some populations are persisting;

however, 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 the long-term risk of extinction, and is likely to contribute to the short-term risk of extinction in the foreseeable future. The ESU's geographic distribution has been moderately reduced, but especially for southern populations in general and spring-run Chinook salmon populations in particular.

Based on the above information, recent status reviews and available information indicate CC Chinook salmon and CV spring-run Chinook salmon are likely to become endangered in the foreseeable future. The extinction risk for the SR winter-run Chinook salmon ESU has increased from moderate risk to high risk of extinction since 2005. Therefore, the likelihood of both survival and recovery are reduced compared to an ESU at low risk of extinction.

The adverse effects from program activities to CC Chinook salmon, SR winter-run Chinook salmon, and CV spring-run Chinook salmon within the action area are not expected to affect the overall survival and recovery of the ESUs. Adverse effects to individuals and habitat include actions that are expected to cause temporary and permanent habitat degradation or removal; increased sedimentation and turbidity; dewatering, capture, and relocation; and hydraulic effects (Section 2.5). The implementation of avoidance and minimization measures, however, would significantly reduce direct and indirect adverse effects of those activities (Section 1.3.9). These actions are expected to result in adverse effects to individuals, and small portions of localized habitat, leading to migration delays, injury or death, and harm. These adverse effects are expected to affect a very small proportion of the ESUs.

2.7.2.4 North American green sturgeon (Acipenser medirostris)

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 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 viability of population abundance indices.

Based on the best available science, there is likely one population of sDPS green sturgeon within the ESU. This increases the risk of extinction to the ESU, and makes it more vulnerable to any action resulting in adverse effects. Green sturgeon are particularly susceptible to changes in benthic habitat, as they rely on such habitat to forage for food. Those proposed actions expected to adversely affect individual green sturgeon include those with temporary benthic habitat disturbance resulting in decreased feeding and growth. Implementation of avoidance and minization measures (Section 1.3.9), however, are expected to temporarily effect only localized areas anda very small proportion of the sDPS.

2.7.2.5 Eulachon (Thaleichthys pacificus)

Eulachon use the estuaries and the first few miles of river mainstems for spawning, incubation, growth, maturation, and migration. Eulachon population abundance has declined significantly since the early 1990s. The 2010 status review of sDPS eulachon determined that the species was at moderate risk of extinction throughout all of its range. Since then, monitoring has demonstrated that sDPS Eulachon populations have generally improved. However, recent poor ocean conditions and the likelihood that these conditions will persist into the near future suggest that population declines may be widespread in the upcoming return years.

Although NMFS considers variation in ocean productivity to be the most important natural phenomenon affecting the productivity of these species, NMFS identified many other factors associated with the freshwater phase of their life cycle that are also limiting the recovery of these species. These factors include, but are not limited to, elevated water temperatures; excessive sediment; reduced access to spawning and rearing areas; and reductions in habitat.

Adverse effects to individuals and habitat include actions that are expected to cause temporary and permanent habitat degradation or removal; increased sedimentation and turbidity; dewatering, capture, and relocation; and hydraulic effects (Section 2.5). These actions are expected to result in adverse effects to individuals, and small portions of localized habitat, leading to migration delays, injury or death, and harm. The implementation of avoidance and minimization measures, however, would significantly reduce direct and indirect adverse effects of those activities (Section 1.3.9). These adverse effects are expected to affect a very small proportion of the DPS.

2.7.2.6 Black abalone (Haliotis cracherodii)

Black abalone populations throughout California face high risk in each of four demographic risk criteria: abundance, growth rate and productivity, spatial structure and connectivity, and diversity (VanBlaricom *et al*. 2009). Threats posed by disease (i.e., withering syndrome), suboptimal water temperatures; and illegal take exacerbate the risk of extinction faced by the species. Threats to black abalone critical habitat include coastal development or in-water construction; activities that can increase sedimentation; oil or chemical spills and response activities; and vessel grounding and response activities.

This proposed project involves activities that are expected to adversely affect black abalone individuals and critical habitat by increasing sedimentation, temporarily or permanently degrading habitat resulting in less habitat for larval recruitment and settlement. Implementation of avoidance and minization measures (Section 1.3.9), however, are expected to temporarily effect only localized areas and a very small proportion of the sDPS.

Recovering the species will involve protecting the remaining healthy populations to the north that have not yet been affected by withering-foot syndrome, and increasing the abundance and density of populations that have already been affected by the disease.

2.7.3 ESU/DPS Survival and Recovery/Critical Habitat Value

Because NMFS can determine that program wide application of the project avoidance and minimizations measures acutely minimize the effects of each project carried out under the programmatic, we find that application of the program is likely to adversely affect a very small number of individual fish per year over the term of the program. Becauses of the few fish affected, the viable salmonid population criteria of abundance, productivity, distribution, or genetic diversity of any salmon or steelhead population to which those individual fish belong will not be negatively affected. This conclusion is also true for eulachon, green sturgeon, and black abalone. The adverse effects of the program on individual fish and/or abalone will be too few to affect the abundance, productivity, distribution, or diversity of eulachon, green sturgeon, or black abalone.

At the ESU or species scale, the status of individual populations determines the ability of the species to sustain itself or persist well into the future, thus impacts to the populations are important to the survival and recovery of the species. Because the VSP characteristics at the population scale will not be affected, the likelihood of survival and recovery of the listed species will not be appreciably reduced by the proposed action.

Based on the above analysis for critical habitats, when considering the status of the species, the effects of the proposed action, when added to the effects of the environmental baseline, and anticipated cumulative effects and climate change, critical habitat will remain functional or retain the current ability for the PBFs to become functionally established, to serve the interested conservation role for ESA listed salmonids, steelhead, eulachon, green sturgeon, and black abalone. Thus, the proposed action is not likely to result in appreciable reductions in the value of designated critical habitat for the conservation of the species.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of North American green sturgeon, Southern Oregon/Northern California Coast Coho salmon, Central California Coast Coho salmon, Southern California Steelhead, South-Central California Coast Steelhead, Central Valley Steelhead, Central California Coast Steelhead, Northern California steelhead, California Coastal Chinook, Central Valley Spring-run Chinook, Sacramento River Winter-run Chinook, Southern DPS Eulachon, and black abalone.

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

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct (16 USC 1532). "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

Work necessary to construct and maintain the projects authorized under the FEMA's Mitigation and Disaster Preparedness Program will take place throughout the Action Area beside and within aquatic habitats that are reasonably certain to be occupied by individuals, or within critical habitat, of the 13 ESA-listed species considered in this consultation. NMFS anticipates that juvenile and adults will be stressed, captured, injured, or killed as a result of Program implementation due to their presence within the Action Area and Program activities.

Juvenile fish will be captured during work area isolation necessary to minimize construction-related disturbance of streambank and channel areas caused by stormwater outfalls, roads, culverts, bridges, and utility lines. In-stream disturbance that cannot be avoided by work area isolation will lead to short-term increases in suspended sediment, temperature, dissolved oxygen demand, or other contaminants, and an overall decrease in habitat function that harms adult and juvenile fish by denying them normal use of the action area for reproduction, rearing, feeding, or migration. Exclusion from preferred habitat areas causes increased energy use and an increased likelihood of predation, competition and disease that is reasonably certain to result in injury or death of some individual fish.

Similarly, adult and juvenile fish are reasonably certain to be harmed by construction-related disturbance of upland, riparian and in-stream areas for actions related to caused by (1) installation, repair, or replacement of facilities, roads, culverts, and bridges; (2) non-emergency debris removal; and (3) wildfire risk reduction activities and related in-stream work. The effects of those actions will include additional short-term reductions in water quality, as described above, and will also harm adult and juvenile fish as described above.

This take will typically occur within an area that includes the streamside, channel, estuary, or marine footprint of each project, and downstream for pathways that are caused by diminished water quality. Projects that require two or more years of work to complete will cause adverse effects that last proportionally longer, and effects related to runoff from the construction site may be exacerbated by winter precipitation. These adverse effects may continue intermittently for weeks, months, or years until riparian vegetation and floodplain vegetation are restored and a new topographic equilibrium is reached. Incidental take is expected to occur in the forms of harm, harass, capture, injury, or death. Incidental take that meets the terms and conditions of this incidental take statement will be exempt from the taking prohibition.

In summary, the best available indicators for amount and extent of take for these proposed actions are as follows. For actions that involve:

- ***Construction-related disturbance of streambank and channel*** – The extent of take indicator is 45,050 linear stream feet per year, as proportioned by NMFS Field Office Jurisdiction (Table 4).

- ***Construction-related disturbance of estuarine/marine waters*** – The extent of take indicator is 7.96 acres of estuarine/marine areas, as proportioned by NMFS Field Office Jurisdiction (Table 4).

- ***Pile Driving*** **–** The extent of take indicator for for piling projects is 5 projects *and* 150 dB RMS behavioral threshold exceeded no more than 13,000 ft from pile, 187db/183dB cumulative SEL threshold exceeded no more than 1,150 ft from pile (Table 4).

- ***Capture of juvenile fish during in-water work area isolation*** **–** The amount of take is 5,400 juvenile salmonids, 10 juvenile green sturgeon, 10 eulachon, and 2 black abalone handled per year, as proportioned by species (Table 5).

2.9.1.1 Harm from Disturbance to Habitat

In some cases, it is impossible to precisely quantify and track the amount or number of individuals that are expected to be incidentally taken (injure, harm, kill, etc.) per species as a result of the proposed action's components due to the variability and uncertainty associated with the response of listed species to the effects of the proposed action, the varying population size of each species, annual variations in the timing of spawning and migration, individual habitat use within the action area, and uncertainty of exact timing and location of each project. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates, those elements of the project that are expected to result in incidental take, that are more predictable and/or measurable, with the ability to monitor those surrogates to determine the extent of incidental take that is occurring.

The most appropriate threshold for incidental take is an ecological surrogate of temporary and permanent habitat disturbance during FEMA's Mitigation and Disaster Preparedness Program activities. This variable is proportional to the amount of harm that the proposed action is likely to cause through short-term degradation of water quality and physical habitat. Program activities are expected to increase sediment, turbidity, temperature, contaminants, and noise, and reduce dissolved oxygen and streambank vegetation in amounts that correlate to the area of stream reach modified. Habitat disturbance is also proportional to the amount of harm that the proposed action is likely to cause through long-term impacts resulting from destruction or removal of riparian habitat; permanent hydrologic effects to the streambed, bank and shoreline; permanent loss or alteration of shallow water habitat; and permanent loss or alteration of mid-channel habitat. Disruption of habitat utilization is expected to result in fish behavioral modifications leading to harm as described below:

1. Harm to listed species from exclusion from preferred habitat areas. This disruption will affect the behavior of listed species, including migration delay and displacement, which is reasonably certain to result in increased energy use and an increased likelihood of predation, competition and disease resulting in reduced growth.

2. Harm to listed fish from underwater noise activities where underwater noise may harass or cause temporary behavioral modification, which is reasonably certain to result in reduced fitness, survival, and growth.

3. Harm to listed species from turbidity increases resulting from habitat-related disturbances during construction activities. Increases in turbidity are reasonably certain to result in harm to the species through modification or degradation of PBFs for rearing and migration that will result in physiological impacts, temporary displacement of individuals, reduced feeding, and increased predation.

Based on historical ESA consultations with FEMA (*i.e.*, the past 10 years), the extent of the 2017 flood disasters in California, and assuming an increase in the frequency and magnitude of disasters when compared to historical period, NMFS adopts FEMA's assumption that approximately 106 actions per year may be funded or carried out under this BO. Based on the Program-level limits established in the FEMA's Proposed Suitability Criteria (Section 1.3.7 and 1.3.8), NMFS estimates that each action may modify up to 500 linear feet of streambed or streambank habitat or up to 0.5 acre of esuarine or marine water habitat. In order to accurately account for project impacts, disturbance from a project would only be applied to either the program level disturbance in linear feet or acres. Projects involving the bed and banks of streams and rivers will use the linear feet of disturbance as the method of reporting, while projects involving estuarine/marine disturbance will be reported as area (acres) of disturbance. Therefore, the yearly extent of take for habitat disturbance of streambank and streambed areas is 45,050 linear feet, and the yearly extent of take for habitat disturbance of estuarine or marine areas is 8.56 acres, both partitioned between field offices (Table 4). The Program-level limits have been projected by multiplying the estimated take by the approximated number of covered projects in the jurisdictional area of each of the NMFS field offices in California. The NMFS jurisdictions were used instead of the range of individual species because, in many areas of habitat, listed species may co-occur. Based on historical data, FEMA has funded more projects that may result in take of listed species in northern and central coastal California than in the southern or the interior part of the State. NMFS assumes that the proposed actions will continue to be distributed among the NMFS field office in the same proportion as in the past and has assigned this take to individual NMFS field offices whenever possible (Table 4).

Table 4. Extent of take indicators for actions authorized or carried out under the FEMA Programmatic, by NMFS Field Office Jurisdiction per year.

NMFS Field Office Jurisdiction	Anticipated Number of Projects Covered*	Estuarine/Marine Waters Extent of Take in acres**	Streambed/Streambank Extent of Take in linear feet***
Long Beach Field Office	8	0.6	3,400
Santa Rosa Field Office	45	3.38	19,125
Arcata Field Office	30	2.26	12,750
Sacramento Field Office	23	1.72	9,775
Pile Driving Projects, All Offices	5	Not to exceed 5 projects and 150 dB RMS behavioral threshold exceeded no more than 13,000 ft from pile, 187db/183dB cumulative SEL threshold exceeded no more than 1,150 ft from pile. ****	Not to exceed 5 projects and 150 dB RMS behavioral threshold exceeded no more than 13,000 ft from pile, 187db/183dB cumulative SEL threshold exceeded no more than 1,150 ft from pile. ****

* Provided to inform the calculation of take estimates, the number of projects covered is not part of the yearly take limit.
** Estuarine/marine waters include all areas below mean higher high water. As based on the project footprint, which includes all temporary and permanent effects to suitable habitat from ground-disturbance and/or vegetation removal in the stream bed and/or bank or shoreline. Individual projects will draw from either the program-level limit of estuarine/marine waters or streambed/streambank, depending on their location.
*** As based on the project footprint, which includes all temporary and permanent effects to suitable habitat from ground-disturbance and/or vegetation removal in the stream bed and/or bank or shoreline. Individual projects will draw from either the program-level limit of estuarine/marine waters or streambed/streambank, depending on their location.
**** Assumes a 24-inch steel pile, 500 strikes per pile, 4 piles per day. Also assumes 5dB attenuation from bubble curtain and a transmission loss of 15. Using sound levels for 24 inch steel pipe pile, ~15m depth in Table I.2-1. of Caltrans 2015.

These take indicators function as effective reinitiation triggers because they are calculated and monitored on an annual basis, and thus will serve as a check on the proposed action on a regular basis. Incidental take will be exceeded if the amount of habitat disturbance described in each of the areas in the table above is exceeded, which would indicate the surrogate is exceeded.

2.9.1.2 Capture of Listed species

For proposed project components in which take through fish and abalone capture and relocation would occur, the magnitude of take may be estimated using the number of individuals affected. NMFS adopts FEMA's proposal to use program-level take limit estimates by number of individuals. Because of the nature of this programmatic consultation, FEMA does not have data on the future types of projects anticipated, their location, nor their extent. Therefore, FEMA has compiled data from historical FEMA ESA consultations and projected historical estimates into the future as a reasonable prediction for program-level take. For species that FEMA has not consulted on in the recent past, consultations completed by other action agencies were used to develop take estimates. Based on historical data, FEMA has funded more projects that may result in take of an ESA-listed species in northern and central coastal California than in southern or the interior part of the state.

For listed species, the amount oftake by injury or mortality is five percent of the take by harassment limit, which is a reasonable value for injury incidental to fish capture and relocation efforts (McMichael *et al.* 1998). Incidental take will be exceeded if the amount of take for any individual species is exceeded (Table 5). FEMA would request reinitiation of ESA consultation if this occurs.

Table 5. Amount of Take per year by species for projects that may involve fish or abalone capture and relocation

Covered Species (DPS or ESU) (Color Coded by Species)	Yearly Program-Level Limits - Take by Harassment	Yearly Program-Level Limits - Take by Injury or Mortality
Steelhead, Southern California DPS	180	9*
Steelhead, South-Central California Coast DPS	540	27*
Black Abalone	2	0
Steelhead Central California Coast DPS	1,080	54*
Coho Salmon, Central California Coast ESU	360	18*
Chinook Salmon, California Coastal ESU	720	36*
Coho Salmon, Southern Oregon-Northern California ESU	360	18*
Steelhead, Northern California DPS	540	27*
Eulachon, Southern DPS	10	0
Chinook Salmon, Sacramento Winter-run ESU	180	9*
Chinook Salmon, Central Valley Spring-run ESU	720	36*
Steelhead, Central Valley DPS	720	36*
Green Sturgeon, Southern DPS	10	0*

DPS = Distinct Population Segment / ESU = Evolutionary Significant Unit

* Take by mortality is limited to juvenile fish for these species and does not apply to adult fish. With implementation of the avoidance and minimization measures, no lethal take of adults is anticipated.

2.9.2 Effect of the Take

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

2.9.3 Reasonable and Prudent Measures

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

The following measures are necessary and appropriate to minimize the impact of incidental take of listed species from the proposed action.

1. FEMA shall minimize incidental take resulting from funded projects by ensuring that all such projects use the AMM's described in the proposed action and analyzed in this opinion, as appropriate.

2. FEMA shall ensure completion of a comprehensive monitoring and reporting program regarding all projects funded by FEMA by preparing and providing NMFS with plan(s) and report(s) describing how impacts of the incidental take of listed species in the action area would be monitored and documented.

3. Each subapplicant receiving FEMA funding shall report and monitor for take pathways within their authority (e.g., revegetation monitoring, underwater noise monitoring, fish rescue and relocation reporting).

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and FEMA, or any other party affected by these terms and conditions, must comply with them to implement the reasonable and prudent measures (50 CFR 402.14). FEMA has a continuing duty to track 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 following terms and conditions are not complied with, the protective coverage of section 7(o)(2) will likely lapse.

1. To implement reasonable and prudent measure #1, FEMA shall ensure that:

    a. For each action funded or carried out under this opinion, avoidance and minimization measures 1 through 33, as appropriate, shall be added as a subapplicant condition.

    b. FEMA shall provide copies of the BO and any NMFS additional project specific requirements to the subapplicants.

2. To implement reasonable and prudent measure #2, the FEMA shall:

    a. Prepare an annual report to NMFS, by March 15, containing a summary of the numbers and types of projects implemented under the BO, which shall include:

        i. A tabular summary of those projects.

        ii. An accounting of take based on number of individuals and/or disturbance to habitat as a surrogate (as appropriate) and a tally of the total from all prior years.

        iii. The project action details, project locations, subapplicant names, and the effects of the action on federally listed species and critical habitat in the action area.

b. For projects that meet the ESA suitability criteria as "NLAA" or "LAA" projects and/or the MSA suitability criteria of "may adversely affect EFH":

   i. FEMA shall ensure that the necessary materials are provided with the ESA/MSA Review Form (Appendix A). The ESA/MSA Review Form shall be submitted to NMFS at least 30-days prior to the start of project construction.

   ii. For those projects that may result in take of a listed species and would be covered under this opinion and the associated ITS, FEMA shall include a take assessment in the ESA/MSA Review Form as described in Section 1.3.4.

c. The FEMA Region IX shall attend an annual coordination meeting with NMFS by May 15 each year to discuss the annual monitoring report and any adaptive management measures needed to minimize impacts.

3. To implement reasonable and prudent measure #3, FEMA shall:

   a. Require the subapplicant completes all project monitoring and reporting (e.g., revegetation monitoring, underwater noise monitoring, fish rescue and relocation reporting).

   b. Require the subapplicant monitors the project area to ensure vegetation plantings meet the 80 percent retention requirement within five years of planting.

   c. Require the subapplicant to provide a monitoring report that will include an assessment of project activity. This report shall include how listed species and habitat will be monitored and any annual maintenance needed for specific sites.

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).

In coordination with the USFWS and NMFS, FEMA is currently developing a Conservation Program in compliance with ESA Section 7(a)(1) for its disaster, mitigation, and preparedness programs in California, Nevada, and Arizona. This Conservation Program would include the following four elements: (1) develop procedures for implementing its disaster, mitigation, and preparedness programs within the context of listed resource conservation; (2) educate subapplicants on species conservation; (3) educate and inform subapplicants to incorporate project design and project planning features for species conservation; and (4) incorporate an ecosystem-services approach into its decision-making process.

Although the specific framework for the Conservation Program is still under development, FEMA has outlined the framework for the Conservation Program, which is included below.

2.10.1 Procedures for Implementing FEMA Programs within the Context of Listed Resource Conservation

FEMA Region IX would continue to develop and implement collaborative efforts with NMFS at the programmatic level. Although FEMA has already initiated these types of collaborative efforts over the past decade, FEMA would continue these efforts with feedback from and through regular interagency communication with NMFS. The most recent example of this effort is the signed 2015 MOU among FEMA, USFWS, NMFS, and USACE.

2.10.2 Education of Subapplicants on Species Conservation

FEMA Region IX would continue to develop an outreach program to educate the subapplicants on conservation efforts for federally listed/proposed species and their habitats. As part of this outreach program, FEMA Region IX is preparing an educational pamphlet that would be distributed to all potential subapplicants. The pamphlet would include information on the following: the general environmental regulatory requirements, federally listed/proposed species and candidate species, critical habitat, EFH, recovery plans for species, access to information in IPaC,[13] the steps and process to comply with the ESA requirements, roles and responsibilities, and communication protocols with Federal and State agencies. The pamphlet would encourage subapplicants to proactively implement conservation efforts to benefit candidate species before those species are listed under the ESA.

As part of this outreach program, FEMA Region IX would also educate the subapplicants on conservation strategies included in recovery plans for federally listed species and encourage them to collect species information prior to, during, and after project implementation, when feasible. This would allow the implementation of strategic habitat conservation already developed for specific species in the recovery plans. The pamphlet would also advise the subapplicants to submit the species information and fish passage information they have collected to:

- CDFW's California Natural Diversity Database – data viewing available through [CDFW's Bios Viewer at https://map.dfg.ca.gov/bios/](https://map.dfg.ca.gov/bios/); and
- Calfish Passage Assessment Database – data viewing available throgh [CDFW's Bios Viewer at https://map.dfg.ca.gov/bios/](https://map.dfg.ca.gov/bios/).

FEMA would encourage the subapplicants to carry out or participate in voluntary activities that promote the recovery of federally listed, proposed, and candidate species. FEMA would coordinate such activities with NMFS before implementation, such as described in this BO.

[13] Information for Planning and Consultation or iPac is a project-planning tool that streamlines the USFWS environmental review process. Available online at https://ecos.fws.gov/ipac/.

2.10.3 Conservation Efforts at Project Design and Project Planning Levels by Subapplicants

FEMA Region IX would educate and inform the subapplicants to incorporate project design and project planning features to avoid, reduce, and prevent potential adverse effects from their projects on federally listed/proposed species, their critical habitats, and EFH to the maximum extent feasible. If subapplicant's engineers design and implement proposed projects in a manner that avoids, reduces, or prevents potential adverse effects on federally listed/proposed species, their critical habitats, and EFH, then federally listed/proposed species and EFH may not be affected at all or adverse effects may be minimized to a level that may result in a simpler and faster ESA consultation for the proposed project. Steps to avoid, reduce, or prevent potential adverse effects would need to be incorporated into project planning and design by the subapplicant prior to applying for funds under a FEMA Program. For example, subapplicants may incorporate the agency guidelines on bioengineering and living shoreline techniques for erosion control in the early stages of their project design.

These early efforts ensure the incorporation of conservation efforts at the project design and planning levels, as opposed to having to incorporate avoidance and minimization measures after the project has already been designed. The subapplicant would incorporate these steps to avoid, reduce, or prevent potential adverse effects in the early stages of design for a proposed project, instead of being required to implement them during or after an ESA consultation between FEMA and NMFS. For these reasons, these efforts would be under ESA Section 7(a)(1) (i.e., a Federal agency would implement a conservation program), as opposed to ESA Section (7(a)(2) (i.e., a Federal agency consults with USFWS and/or NMFS on a proposed project).

2.10.4 Incorporating Ecosystem Services into FEMA's Decision-making Process

The term "ecosystem services" has been coined to express the value of natural systems to human well-being. Some examples of the benefits that ecosystem services may provide include the purification of air and water, detoxification and decomposition of wastes, regulation of climate, regeneration of soil fertility, and production and maintenance of biodiversity, from which key ingredients of our agricultural, pharmaceutical, and industrial enterprises are derived. Maintaining those ecosystem services in turn provides indirect benefits to federally listed/proposed species by protecting or maintaining habitat quality for those species, maintaining migration corridors, and providing habitat connectivity, among others.

FEMA would incorporate ecosystem services into its decision-making process. Some examples include:

- Using an interactive science-policy process;
- Implementing adaptive management;
- Training FEMA Region IX grants participants (i.e., staff from FEMA staff, Cal OES, subapplicants, and FEMA contractors) in the approaches and tools to incorporate ecosystem protection;

- Implementing a qualitative value of the benefits of ecosystem services into the FEMA grants selection process;
- Implementing a valuation of and incentives for conservation measures taken by the subapplicants;
- Assisting FEMA incorporate ecosystem services into its mission, strategies, and work plans; and
- Evaluating costs and benefits of ecosystem services in FEMA-funded projects.

2.11 Reinitiation of Consultation

This concludes formal consultation for FEMA's funding of grant programs related to disaster, mitigation, and preparedness 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 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 FEMA and descriptions of EFH for Pacific Coast groundfish (PFMC 2005), coastal pelagic species (PFMC 1998), Pacific Coast salmon (PFMC 1999), and highly migratory species (PFMC 2007) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

Within the Action Area, EFH designations have been made for all estuarine and coastal waters of California as well as many inland watersheds that support salmon. The following FMPs designate EFH covered under this BO (Figures 4A and 4B):

- Pacific Coast Salmon FMP
- Coastal Pelagic Species FMP
- Pacific Coast Groundfish FMP
- Highly Migratory Species FMP

3.2 Adverse Effects on Essential Fish Habitat

Based on information provided by the action agency and the analysis of effects presented in the ESA portion of this document, NMFS concludes that the proposed action will have adverse effects on EFH designated for Pacific Coast salmon in freshwater where projects will occur. Pacific salmon, groundfish and coastal pelagic species will also be adversely affected in estuaries, including estuarine areas designated as habitat areas of particular concern (HAPCs) in the San Francisco Bay, Suisan March, and at other river mouths, bays, estuaries, and coastal waters where projects will occur.

1. **Water Quality (spawning, rearing, and migration).** The project has the potential to increase temperature through vegetation removal, introduce chemical contaminants through construction activities, and increase sediment, stormwater runoff, and dissolved

oxygen demand from vegetation disturbance and construction. AMMs such as erosion control measures utilizing silt fences, vegetated ditches, and work in the dry and short duration of activities will minimize effects to water quality. Because of the AMMs that FEMA will implement, the low probability of a large spill, and the low intensity and short duration of any resulting effect from small drips/leaks, effects to water quality will be very minor. Long-term beneficial effects includes the potential to improve riparian function, floodplain connectivity, and improved stormwater treatment.

2. **Water Quantity (rearing and migration).** The project has the potential to reduce water quantity due to short-term construction needs, reduced riparian permeability, and increased riparian runoff. Long-term beneficial effects includes the potential to improve water quantity based on improved riparian function and floodplain connectivity.

3. **Safe Passage (migration).** Fish passage will be impaired in the short-term due to decreased water quality and in-water work isolation, and improved over the long-term due to improved stream-road crossing structures, water quantity and quality, habitat diversity and complexity, forage, and natural cover.

4. **Substrate (migration & spawning).** Substrate will have a short-term reduction in quality due to increased compaction and sedimentation, and a long-term increase in quality due to gravel placement, and increased sediment storage from boulders and large wood.

5. **Forage (rearing and migration).** Forage will have a short-term decrease in availability due to riparian and channel disturbance and a long-term increase in availability due to improved habitat diversity and complexity, and improved riparian function and floodplain connectivity.

6. **Cover/shelter (rearing and migration).** Natural cover will have short-term decrease due to riparian and channel disturbance, and a long-term increase due to improved habitat diversity and complexity, improved riparian function and floodplain connectivity.

7. **Floodplain Connectivity (rearing and migration).** The project will have a short-term decrease due to increased compaction and riparian disturbance during construction, and a long-term improvement due to streambank stabilization methods that incorporate riparian vegetation.

8. **Estuarine and nearshore EFH quality** (rearing and migration) will be temporarily reduced due to short-term releases of suspended sediment, benthic disturbance, and damage to submerged aquatic vegetation. Affected habitats includes:

   - Water column
   - Estuary (HAPC)

   Long-term reduction in nearshore habitat through the disturbance associated with in-water and over-water structures, boat use, and removal of riparian vegetation resulting in the reduction of allochthonous input to the nearshore.

9. Shading of submerged aquatic vegetation and resulting reduction in submerged aquatic vegetation density and abundance related primarily from over-water structures.

3.3 Essential Fish Habitat Conservation Recommendations

Because the properties of EFH that are necessary for the spawning, breeding, feeding or growth to maturity of managed species in the action area are the same or similar to the biological requirements of ESA-listed species as analyzed above, NMFS has provided two conservation recommendations.

The following conservation recommendations are necessary to avoid, mitigate, or offset the impact of the proposed action on EFH:

1. Ensure completion of a monitoring and reporting program as described in term and condition numbers 1 and 2 in the accompanying opinion to verify the action is meeting its objective of minimizing habitat modification from funded activities.

2. As appropriate to each action funded under this opinion, include the avoidance and minimization measures as enforceable grantee conditions.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, FEMA must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The FEMA 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 document is helpful, serviceable, and beneficial to the intended users. The intended users is the Federal action agency, FEMA.

The opinion in this document concludes that the proposed action for the FEMA Endangered Species Programmatic will not jeopardize the affected listed species or result in the adverse modification of their critical habitat. Therefore, FEMA can fund this action in accordance with its authority under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended and Emergency Management-related Provisions of the Homeland Security Act, as amended FEMA 692, August 2016.

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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6. LIST OF APPENDICES

These Appendices follow as separate documents or files:

Appendix A: ESA/MSA Review Form

Appendix B: NMFS Fish Passage Guidelines (The most current fish passage guidelines are subject to change)

Appendix C: FEMA In-Water Work Windows

Appendix D: Fish Screening Criteria for Anadromous Salmonids (NMFS 1997)

Appendix E: Bioengineering Techniques