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

DEC 1 4 2015 Refer to NMFS No: WCR-2015-2576

Merv George Jr.
Forest Supervisor
Six Rivers National Forest
1330 Bayshore Way
Eureka, CA 95501

Re: Six Rivers National Forest's (SRNF) Watershed and Fisheries Restoration Program
Biological Opinion

Dear Mr. George:

On April 24, 2015, NOAA's National Marine Fisheries Service (NMFS) received your letter requesting initiation of formal consultation pursuant to section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.)* for the Six Rivers National Forest's (SRNF) Watershed and Fisheries Restoration Program (WFR Program). The ESA consultation concerns the potential effects of a 15-year program designed to restore watershed processes and enhance instream habitat throughout the Six Rivers National Forest. The SRNF prepared and provided NMFS with a biological assessment (BA), which determined that certain project activities covered under the WFR Program were likely to adversely affect listed species and their designated critical habitat.

This letter transmits NMFS final biological opinion and Essential Fish Habitat (EFH) consultation pertaining to the proposed Watershed and Fisheries Restoration Program in the Six Rivers National Forest.

The biological opinion is based on NMFS' review of information provided within SRNF's April 24, 2015 request for formal consultation, the program BA (updated July 2015), additional information provided to NMFS prior to initiation of consultation, and the best available science. The biological opinion addresses potential adverse effects on the following listed species Evolutionarily Significant Units (ESU) and designated critical habitat in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 § *et seq.*):

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

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

Based on the best scientific and commercial information available, NMFS concludes that the WFR Program, as proposed, is not likely to jeopardize the continued existence of the SONCC ESU of coho salmon or NC steelhead DPS, and is not likely to result in the destruction or adverse modification of designated critical habitat for the species. NMFS expects that certain activities of the WFR Program will result in incidental take of SONCC coho salmon and NC steelhead. An incidental take statement is included with the enclosed biological opinion. The incidental take statement includes non-discretionary reasonable and prudent measures and terms and conditions that are expected to further reduce anticipated incidental take of SONCC coho salmon and NC steelhead. NMFS has also concurred with the SRNF's determination that the WFR Program may affect, but is not likely to adversely affect, California Coastal (CC) Chinook Salmon ESU (*O. tshawytscha*) and its designated critical habitat.

The enclosed EFH consultation was prepared pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act. The proposed action includes areas identified as EFH for coho salmon, Pacific Salmon species managed under the Pacific Coast Salmon Fishery Management Plan (*revised through* Amendment 18, 2014). Based on our analysis, NMFS concludes that the proposed Program would adversely affect EFH for Pacific salmon.

NMFS appreciates the SRNF's efforts to recover listed salmon and steelhead and we look forward to partnering with you on habitat restoration projects. Please contact Ms. Leslie Wolff in Arcata, California at (707) 825-5172 or leslie.wolff@noaa.gov if you have any questions regarding this consultation.

Sincerely,

Garry Stern

for William W. Stelle, Jr.
Regional Administrator

Enclosure:
Biological Opinion

cc: Karen Kenfield, Six Rivers National Forest
bcc: CHRON File AR #151422WCR2015AR00132
Division- File copy

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

Six Rivers National Forest Watershed and Fisheries Restoration Program

NMFS Consultation Number: WCR-2015-2576

Action Agency: USDA Forest Service, Six Rivers National Forest

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species or Critical Habitat?*	Is Action Likely To Jeopardize the Species?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Southern Oregon/Northern California Coast (SONCC) coho salmon ESU (*Oncorhynchus kisutch*)	Threatened	Yes	No	No
California Coastal (CC) Chinook Salmon ESU (*O. tshawytscha*)	Threatened	*No	N/A	*No
Northern California (NC) steelhead DPS (*O. mykiss*)	Threatened	Yes	No	No

*Please refer to section 2.10 for the analysis of species and critical habitat that are not likely to be adversely affected.

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

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

Issued By: for [signature]

William W. Stelle, Jr.
Regional Administrator

Date: DEC 1 4 2015

TABLE OF CONTENTS

1. INTRODUCTION

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

1.1 Background

The Six Rivers National Forest's (SRNF) Watershed and Fisheries Restoration Program (WFR Program) goals are to implement the Aquatic Conservation Strategy (ACS) which was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems on federal lands (FEMAT 1993). In meeting the objectives of the ACS, the WFR Program implements restoration activities identified in the California Department of Fish and Game (CDFG) Recovery Strategy for California Coho Salmon (CDFG 2004), and NOAA's National Marine Fisheries Service (NMFS) Final Recovery Plan for Southern Oregon/Northern California Coast (SONCC) Coho Salmon (NMFS 2014). The WFR Program will reduce stressors and threats to salmonid populations and their habitat over the long term, and provide for short and long term improvements in habitat quality for salmonids.

All proposed activity categories comply with the Record of Decision and Standards and Guidelines of the Northwest Forest Plan (USDA and USDI 1994) as incorporated into the Six Rivers and Klamath National Forest land and resource management plans (LRMPs). The Ukonom Ranger District (RD) of the Klamath National Forest (KNF) is included in the WFR Program because it is co-managed with the SRNF's Orleans Ranger District (i.e., the two Ranger Districts are considered one management unit). All proposed WFR Program activities are also identified in the state and federal recovery plans (CDFG 2004, NMFS 2014, NMFS 2015).

The WFR Program actions can occur on a routine basis or sporadically, for the next 15 years (from date of signature), based on SRNF staffing and funding levels. This programmatic approach provides SRNF with a consistent methodology to design, implement, monitor, and document watershed and fisheries restoration activities in support of the ACS and state and federal recovery plans. The WFR Program categories and project level activities are predictable as to their effects to listed species and consistent with broad-scale aquatic conservation strategies and the best available science. The programmatic approach also provides NMFS with the opportunity to streamline section 7 consultations and to work with the SRNF upfront to design a program that is consistent with NMFS recovery plans.

Forest Service Direction

While developing individual projects that are part of the WFR Program, SRNF will meet and implement direction from both the Forest Service and partnering regulatory agencies. Many plans and programs were used to develop the WFR Program. The WFR Program will adhere to the goals, objectives, standards and guidelines of:

- The Six Rivers and Klamath National Forest Plans [SRNF/KNF LRMPs (USDA 1995 a, b)];
- Federal and State recovery plans for listed salmonids; (3) *Threatened, Endangered and Sensitive Plants and Animals* [Forest Service Manual (FSM) 2670, September 2005

(USDA 2005)];

- *Clean Water Act/Water Quality Management Objectives* [Forest Service Handbook (FSH) 2509.22, December 2011 (USDA 2011b)], including the Categorical Waiver of Waste Discharge Requirements for Nonpoint Source Discharges Related to Certain Federal Land Management Activities on National Forest System (NFS) Lands (Waiver). This Waiver addresses activities associated with National Forest Service management that may generate sediment, affect shade canopy, or influence other water quality parameters of waters of the state;
- *Watershed Condition Framework* (USDA 2011a).

WFR Program Goals

To achieve LRMP goals, objectives of the Aquatic Conservation Strategy, and to work toward achieving the NMFS recovery plan goals (NMFS 2014, 2015), the WFR Program proposes to:

- Improve instream conditions for salmonids;
- Improve impaired water quality and reduce the risk of road and trail related sediment from entering the stream system, especially during high precipitation events;
- Improve upstream and downstream passage conditions for all life stages of salmonids and restore or improve continuous paths for wood, nutrients, sediments, and other vegetative material essential for quality fish habitat;
- Improve riparian conditions to maintain or increase shade, increase large woody debris recruitment, increase input of nutrients and macroinvertebrates;
- Reduce impacts from other land management activities such as historic mining activities, recreation, and livestock grazing currently impacting water quality, and,
- Reduce impacts from identified illegal marijuana grows when aquatic resources are at risk.

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR 402. We also completed an essential fish habitat (EFH) consultation on the proposed program, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available through NMFS' Public Consultation Tracking System [*https://pcts.nmfs.noaa.gov/pcts-web/dispatcher/trackable/WCR-2015-2576?overrideUserGroup=PUBLIC&referer=%2fpcts-web%2fpublicAdvancedQuery.pcts%3fsearchAction%3dSESSION_SEARCH*]. A complete record of this consultation is on file at the Arcata, California NMFS office.

1.2 Consultation History

WFR Program Consultation

On April 24, 2015, NMFS received a letter from the SRNF (April 22, 2015, letter from M. George, SRNF to W. Stelle NMFS) requesting consultation on the effects of the WFR Program pursuant to section 7(a)(2) of the Endangered Species Act (ESA), as amended (16 U.S.C. 1531 *et seq*.) and its implementing regulations (50 CFR Part 402). Included with the request for consultation NMFS received a biological assessment (BA) prepared by the SRNF describing the proposed program, and its potential effects on listed salmon and steelhead, dated April 22, 2015. On May 8, 2015, NMFS responded to the SRNF that we had sufficient information to initiate consultation, and that a biological opinion analyzing the effects of the WFR Program would be available by September 6, 2015.

The April 22, 2015 BA was edited through a series of team meetings (May 27, June 11, June 19, and June 25) to clarify details (e.g., monitoring and project tracking and notification process) of the proposed action and effects sections, and to provide more detailed maps. A complete list of changes between the April 22, 2015 BA and the July 13, 2015 BA is available on file in the Arcata, California NMFS office.

On September 4, 2015, NMFS requested a 60-day extension of the consultation period to allow additional time to conclude consultation. With the extension, NMFS was expected to issue the BO on November 5, 2015.

Previous Consultations

Previous consultations on watershed and fisheries restoration have occurred on the Six Rivers National Forest and throughout the range of listed salmon and steelhead throughout the Pacific Northwest. These previous consultations include programmatic BAs and Biological Opinions (BOs) that have addressed instream restoration, road maintenance, road decommissioning, culvert removal, and related road repair activities.

In addition, the SRNF has previously consulted on travel management plans, which designate the minimum road and trail network as per the Forest Service 2005 Travel Management Rule (36 CFR Part 212). This rule established policies and procedures to ensure that the use of motorized vehicles on public lands would be controlled to protect resources, promote safety and minimize conflicts among various uses of those lands. Appendix A-3 of the BA (USDA SRNF 2015) lists the status of all SRNF road and trail inventories, analyses and NEPA documents completed to date. Previous consultations have included road decommissioning, upgrading, storm proofing, OHV trail designation and road/trail maintenance.

In 2007 the SRNF consulted with NMFS on the Orleans Ranger District Travel Management Plan. NMFS prepared a letter in response to the Forest’s consultation request, concurring with the SRNF’s determination of may affect, not likely to adversely affect SONCC coho salmon. Activities and design features of this previous consultation are consistent with the WFR Program activities described in this BO. Approximately 90 percent of the actions under this previous consultation have been implemented, for more information refer to Appendix E (Status of Past Consultations) in the BA (USDA SRNF 2015) for remaining work activities under the Orleans Travel Management Plan.

Also in 2007, NMFS issued a letter concurring with the determination of may affect, not likely to adversely affect for the SRNF's Smith River Travel Management Plan. However, project implementation was delayed, and a draft Environmental Impact Statement (EIS) for this project was released in September 2014. Activities and design features of this project are consistent with the WFR Program activities (including OHV trails) described in this BO.

In 2010, the SRNF requested consultation on the Lower Trinity/Mad River Travel Management Plan. This consultation included designating roads and trails for motor vehicle use, but did not include decommissioning or road upgrades. However, road and trail maintenance activities and design features of this project are consistent with WFR Program activities. The SRNF received a letter from NMFS concurring with the SRNF's may affect, not likely to adversely affect determination for this project.

This WFR Program BO supplements or replaces all previous SRNF (including Ukonom RD) watershed and fisheries restoration (including travel management plans) programmatic and batched consultations. Future restoration actions that are consistent with the WFR Program will use the process described in this biological opinion, and will be covered by this BO.

1.3 Proposed Action

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

Scope of Activities

While the Forest is interested in partnering with state, private and tribal landowners on recovery actions for listed salmon and steelhead, this consultation covers those actions carried out on Forest Service administered lands. This consultation may also cover actions that occur on non-Federal lands when that action is located immediately adjacent to Six Rivers National Forest and the project helps achieve FS aquatic restoration goals as covered under Wyden Amendment authority (16 U.S.C. 1011(a), as amended by Section 136 of PL 105-277).

Projects that include any of the following elements would be outside the scope of this consultation:

- Building new system roads –Temporary access for heavy equipment may be constructed (see section starting on page 15), however would be rehabilitated post-activity, thereby restoring hydrologic function, riparian vegetation and long term soil productivity.
- Use of gabion baskets or chemically-treated timbers for any instream structures would not fall under this consultation. This program focuses on restoring natural process and structure.
- Activity that substantially disrupts the movement of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through an action area.
- Activities such as stabilizing stream banks solely as a mitigation for non-aquatic restoration actions.
- Activities inconsistent with the ACS.

Limits on Area of Disturbance for Individual Projects

In order to avoid cumulative impacts due to multiple projects being implemented at once, limits on the amount of disturbance per year in a single watershed are described on page 38. The number of sediment-producing projects (i.e., instream habitat improvement, instream barrier removal, stream bank stabilization, fish passage improvement, creation of off-channel/side channel habitat, and upslope road work) will be limited by the watershed size (Table 2).

List of Activities Covered

This WFR Program includes 17 aquatic restoration activities that will maintain, enhance and/or restore watershed processes. The Program is intended to include those aquatic restoration activities that are predictable as to their effects to ESA- and MSA-listed species, and are consistent with broad scale aquatic conservation strategies and the best available science.

The SRNF is currently unaware of any potential fish passage improvement projects in occupied habitat; however this project type is being included due to the potential for partnership projects under the Wyden Agreement or for special use permits issued by SRNF. These activities would need to follow the process described (including design features) to be covered under this WFR Program. New types of restoration activities would be brought forward to the Level 1 Annual Coordination Meeting to determine if they meet the requirements for this Program.

Covered Activities:

Fish Access to Habitat/Habitat Connectivity

1. Fish Passage Restoration – all life stages (instream/flow related, weir modification, culvert replacement) and reconnecting downstream movement of habitat components through road related actions

Instream Habitat Enhancement

2. Large Wood and Boulder Projects (adding wood and boulders, engineered log jams, boulder weirs)
3. Gravel Augmentation
4. Legacy/Historic Structure Improvements or Removal (instream enhancements, water flow controls/diversions, etc.)
5. Beaver Habitat Restoration

Side-Channel/Off Channel

6. Off- and Side-Channel Habitat Restoration

Streambank Restoration

7. Streambank Restoration (including toe of landslide treatments)
8. Reduction/Relocation of Recreation Impacts
9. Livestock Fencing, Stream Crossings, and Off-Channel Livestock Watering

Riparian Restoration

10. Riparian restoration and enhancement (planting, alder girdling for conifer growth)

11. Non-native Invasive Plant Control

Road Related Actions

12. Road and Trail Erosion Control (road/trail maintenance, and stormproofing)
13. Decommissioning Roads (including unauthorized non-system routes)

Other

14. Reduction of Impacts related to Illegal Marijuana Grow Clean up

15. Mine Reclamation

16. In-channel Nutrient Enhancement

Table 1 demonstrates the way WFR Program activities address watershed-scale processes that control delivery of sediment, water, organic matter, nutrient and chemicals, light and heat, and biota from the surrounding environment into floodplains and stream channels (Beechie et al. 2010).

Table 1. Connection of WFR Activities to Process-based Restoration (adapted from Beechie et al. 2010)

Ecosystem Features	Natural Driving Process	Aquatic Conservation Strategy Objectives	WFR Activities
Watershed Scale			
Sediment	Sediment delivered to river systems through land sliding, surface erosion and soil creep	Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	2 – 9, 12, 13, 14, 15
Hydrology	Runoff delivered to streams through surface and subsurface flow paths	Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	4-7, 10, 12, 13, 14
Organic Matter	Tee fall and leaf litter fall	Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation	2, 5, 7, 10, 11
Light and Heat	Solar insolation and advective heat transfer to water column	Maintain and restore species composition and structural diversity of riparian plant communities to provide summer and winter thermal regulation.	2, 5, 7, 10, 11
Nutrients	Delivery of nutrients via surface and subsurface flow	Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing.	2, 4-10, 12, 13, 15
Biota	Migration of aquatic organisms, seed transport	Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian species.	1, 2,4, 5, 6, 7, 9, 10, 12, 13, 14

Ecosystem Features	Natural Driving Process	Aquatic Conservation Strategy Objectives	WFR Activities
Reach Scale			
Channel morphology and habitat structure	Channel migration, bank erosion, bar formation, and floodplain sediment deposition create a dynamic mosaic of main-channel, secondary-channel, and floodplain environments. Wood recruitment results in part from bank erosion and channel migration, and wood accumulations reduce bank erosion rates or enhance island formation. Sediment and wood transport and storage processes drive channel cross-section shape, formation of pools, and locations of sediment accumulation. Bank reinforcement by roots reduces bank erosion rates and may force narrowing and deepening of channels. Animals such as beaver physically modify the environment and create new habitats.	Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations. Maintain and restore species composition and structural diversity of riparian plant communities to provide for channel migration and amounts and distributions of woody debris to sustain physical complexity and stability.	1-11
Thermal regime	Local stream shading and exchange of water between surface and hyporheic flows regulates stream temperature at the scale of habitat units and reaches.	Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation	2, 5, 7, 10, 11
Water chemistry	Delivery of dissolved nutrients through groundwater and hyporheic exchange; uptake of nutrients by aquatic and riparian plants. Delivery of pesticides and other pollutants at point sources damage health and survival of biota.	Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of nutrient, routing.	2, 4, 5, 6, 7, 8, 10, 12, 13, 15
Riparian species assemblages	Seedling establishment, tree growth, succession drive reach-scale riparian plant assemblages.	Maintain and restore species composition and structural diversity of riparian plant communities to provide summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of woody debris to sustain physical complexity and stability.	2, 5, 7, 10, 11
Aquatic Species Assemblages	Photosynthesis drives primary production of algae and aquatic plants. Leaf-litter inputs drive detritus based food web strands. Habitat selection, predation, feeding, growth, and competition drive species composition of invertebrate, amphibian, and fish assemblages.	Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	2, 5, 7, 10, 11

The SRNF proposes to implement watershed and fisheries restoration activities as described in the WFR BA (USDA SRNF 2015) over a 15 year period. The key to successful implementation of the WFR Program is the decision making process and the SRNF's pattern of practice or "track record" in successfully implementing projects within the WFR Program decision framework.

As part of the WFR Program, the following large scale NEPA projects are currently under development and would implement many of the actions described under this WFR Program consultation. These projects have been developed concurrently with the WFR Program and follow the Program framework. Additional information on these projects, including maps, is available in the WFR Program BA (USDA SRNF 2015). Additional projects, including road decommissioning, are being developed to fit within the WFR Program framework.

1. Six Rivers National Forest Aquatic Restoration Environmental Assessment (EA) – 2015 to 2030

This project would implement riparian and instream restoration activities designed to meet ESA listed species recovery objectives. This project is currently in the scoping period and, based on a final NEPA decision, would be implemented across the Forest as indicated in the table and maps in Appendix G-1 of the BA (USDA SRNF 2015). Activities included in this project are:

- Fish Access to Habitat
- Instream Habitat Enhancement (Large wood, gravel augmentation, beaver habitat restoration)
- Side-Channel/Off-channel Restoration
- Streambank Restoration
- Riparian Restoration and Enhancement
- Other (i.e., reduction of impacts from marijuana grows, mine reclamation, nutrient enhancement)

2. Smith River National Recreation Area Restoration and Motorized Travel Management Final Environmental Impact Statement (FEIS) – 2015 to 2030

This project implements the 2005 Travel Management Rule to provide access and recreation opportunities while reducing the risk to ecological resources in the Smith River watershed. This project proposes to reduce existing resource impacts to water quality by restoring drainage patterns, decommissioning roads and storm-proofing remaining road network. This project is due would be implemented following a final NEPA decision. Activities included in this project:

- Reduction/Relocation of Recreation Impacts
- Road and Trail Erosion Control
- Decommissioning Roads

3. **Six Rivers Forest Wide Road Maintenance Proposed Categorical Exclusion (CE) – 2015 – 2022**

This project would authorize maintaining roads across the Forest to provide for safe travels and to reduce the risk of sediment entering water courses. This project also implements a consistent annual review process for ensuring water quality objectives are met while maintaining the road network. See the project descriptions in Appendix G-3 of the BA for more information.

The maps associated with this project (USDA SRNF 2015) show the existing road network that would be maintained under current Travel Management decisions. Future Travel Management Decisions (i.e., Smith River National Recreation Area Restoration and Motorized Travel Management FEIS) would reference/incorporate this road maintenance CE and update the road network needing maintenance.

- Road and Trail Erosion Control
- Reducing the risk of road failure during storm events

Program Description/Project Process

Annual Level 1 Team Coordination and Project Tracking

As per the 2013 Streamlining Memorandum of Understanding (MOU) between NMFS and the USFS, WFR Program administration will be guided by the Local Operating Guidelines between the NMFS Arcata Office and the Six Rivers National Forest. The Local Operating Guidelines (USDA SRNF 2015) were updated in March, 2015, in order to be current and included in the development of the WFR Program.

The Level 1 team (see Streamlining MOU and Local Operating Guidelines for more information) will meet annually, once at a minimum, or the more typical, once per calendar quarter to review and discuss watershed and aquatic restoration projects planned for implementation during an upcoming work season (i.e., Project Notification). The number of times the Level 1 team meets would be based on the number and complexity of the projects proposed. Not all projects are required to come forward to the Annual Coordination meeting (see Project Notification section below). The Level 1 team will also review the previous year's projects that were covered under the WFR Program (i.e., Project Compliance Tracking) in order to review implementation, compliance, effectiveness, and adaptive management information.

Integration of WFR Program Components into Project Development

Key to the WFR Program is successful implementation of the design criteria. To that end, General Aquatic Conservation Measures and Project Design Criteria (PDC) listed in the WFR Program BA (USDA SRNF 2015) would be incorporated into the NEPA, contract language, and agreements or force-account implementation plans by the SRNF. All applicable USFS Pacific Southwest Region Best Management Practices (BMPs) will be implemented for land disturbing activities or projects that may impact water quality. Forest Service project biologists and hydrologists ensure this by reviewing NEPA decisions, as well as draft contracts and agreements prior to finalization or awarding.

WFR Program, NEPA and the Notification Process

Project level actions will be proposed and documented during the NEPA analysis for projects that fit under the WFR Program. This will occur for individual projects under the large scale NEPA efforts listed above, and for future individual projects as well.

Project level activities can be analyzed using the following criteria (from the Analytic Process, NMFS 2004)[1] to determine where impacts have a probability of occurring. Based on this analysis, each individual activity under this WFR Program can be demonstrated to have a range of activities from "no effect" to "may affect likely to adversely affect" depending on the following:

Proximity ~ the geographic relationship between the project element or action and the species and their habitat. Activities under this WFR Program range from being within anadromous salmonid habitat (e.g., instream enhancement) to upslope actions designed to reduce impacts or lower risk of impacts occurring (e.g., road decommissioning/road maintenance).

Probability ~ the likelihood that the listed species or habitat will be exposed to the biotic or abiotic effects of the project elements. Actions that have a higher probability of delivering sediment into the stream system (hydrological connectivity) would have a higher probability of causing an effect. Once that sediment enters the stream channel, the distance to anadromous habitat (as indicated on map) can be determined. Other considerations in determining if an effect could occur are the number of individuals present and the condition of the watershed (environmental baseline).

Magnitude, Duration and Timing ~ the severity and intensity of the effect (level of response to a stressor), how long the activity may cause an effect, and the life stage at which the effect may be felt.

If the activity is proximal to listed salmonid habitat and the outcome of the probability step is not entirely discountable or insignificant, determine the severity and intensity of the effect to habitat components and species. Consider the limits established for each activity and watershed to reduce the likelihood that multiple activities would result in an aggregate of effects occurring.

Project Notification

The following describes when projects should be brought forward to the Level 1 Annual Coordination Meeting for pre-implementation review and when project information would be shared with NMFS. The Level 1 Annual Coordination Meeting will occur each year of the WFR Program during the first quarter of the calendar year (usually January) and will focus on tracking WFR Program accomplishments from the previous year, and discussing intended WFR Program activities for the upcoming construction season. All projects that are greater than a no effect will be discussed at the Annual Coordination Meeting and tracked in the annual report to NMFS of WFR Program accomplishments, but not all projects will require pre-construction notification, as described below.

[1] The process described here is an example of the analysis necessary to make a determination of effects on listed species. Other analysis (matrix of pathways and indicators, stress-response, FSM 2670) can be used in the site specific analyses under this WFR Program as long as it meets the requirements of law, policy and regulation.

1. **Notification Not Required**

Projects that have either no effect or an extremely low anticipated effect (based on type of project, proximity and potential for aggregated effects) to listed species and their habitat would not need to be brought forward during the Annual Level 1 meeting. However, consistency with the WFR Program would be documented via the NEPA decision or, in the case of the multi-year NEPA decisions described above, the tracking/compliance process identified within the NEPA document (see "Multi-year Program NEPA" section below). If a project under this category is counted as a SRNF watershed or fisheries accomplishment, it will be included in the annual report to NMFS of WFR Program accomplishments.

2. **Notification Not Required Prior to Implementation**

Projects considered to be 'not likely to adversely affect' do not require notification to NMFS prior to implementation, but will require tracking and reporting. These projects may have some insignificant or discountable level of effect, positive or negative, and do not result in take of a listed species or adverse effects to critical habitat. Projects may be located within or near listed species habitat. These projects do not require notification prior to construction but would require tracking by watershed and would be shared at the annual Level 1 meeting for tracking activities, and would be included in the annual report to of WFR Program accomplishment that is provided to NMFS.

3. **Notification Required Prior to Implementation**

Projects that have the potential (based on proximity, probability and magnitude analysis or stressor/response analysis) to result in a "may affect, likely to adversely affect" determination to listed species or designated habitat would require notification prior to construction (at the Annual Coordination Meeting, as well as before construction begins) and would also be included in the annual report of WFR Program accomplishments.

- Any project that involves listed fish handling or potential for harm (e.g., displacement, etc.) to occur due to type of action and/or actions occurring near or within occupied habitat.
- Projects that may result in short term minor sediment delivery or turbidity, temporary change in flow conditions, or species disturbance, if the changes to habitat or disturbance to species cannot be discounted (i.e., determined to be at the likely to adversely affect level) and the project results in a long term benefit to aquatic ecosystems.
- Projects that may involve temporary change in flow conditions, or, in the case of improving water diversion locations, involve setting minimum flows that could affect fish movement or cool water refugia.
- Any project that involves full spanning structures or engineered projects in habitat occupied by listed species.
- Any project proposing a Minor Variance to WFR Program measures.
- Any projects proposing extensions to the NOS (normal operating season).

Projects that result in a solely negative effect (without long term benefit to species or habitat) are not included in the WFR Program and would require separate project consultation.

The following information will be provided to the Level 1 team prior to the Annual Level 1 Coordination meeting, for all projects above the no effect level. The need for post project compliance monitoring would be identified based on the information provided during project notification. An example Project Notification Form is provided in WFR Program BA (USDA SRNF 2015), however as long as the following information is provided, the form is not required:

a. Project Name – Use the same project name from notification to completion (i.e., Jones Creek 2015 Culvert replacement).
b. NEPA Document Name and Date
c. Location – watershed/stream name, and latitude and longitude (decimal degrees) or map
d. Forest Service Contact – Agency and project lead name
e. Timing – Project start and end dates, potential need to work outside of the normal operating season (NOS)
f. Activity Type
g. Project Description – brief narrative of the project and objectives
h. Extent – number of stream miles or acres to be treated and miles of habitat benefited
i. Fish Information
    i. Species affected
    ii. Distance to occupied habitat
    iii. Fish handling required (seining/block net/electrofishing/dewatering)
j. Verification –verification that all appropriate General Aquatic Conservation Measures, Project Design Criteria for WFR activities have been thoroughly reviewed and will be incorporated into project design, implementation, and monitoring as appropriate based on project specifics. The Level 1 team may request additional verification dependent on the scope and scale of the project.
k. Minor Variances:
    i. Cite the restoration activity and the design feature that needs variance
    ii. Define the requested variance
    iii. Explain why the variance is necessary
    iv. Provide rationale for why the requested variance will either provide an equal conservation benefit or, at a minimum, not cause additional adverse effects that are not described in this BO.
l. Effects determination of project
m. Project lead fish biologist's signature

Multi-year NEPA Projects

For the multiple year NEPA projects implementing any of the restoration activities, the Level 1 Annual Coordination Meeting would serve as a checkpoint for continued compliance with the design criteria and salmonid minimization measures. If changes to the project need to occur or the specific project results in impacts different than those analyzed in this BO, then this annual process would identify the need to re-initiate consultation.

Minor Variance Process

Because of the wide range of proposed activities and the natural variability within and between stream systems, some projects may require minor variations from project design criteria specified herein. Criteria that are also identified as LRMP Standards and Guidelines cannot be changed or modified without a plan amendment, and therefore cannot occur as part of this consultation. Best Management Practices would always be implemented to meet obligations under the Waiver and Clean Water Act. The SRNF proposes the following variance process when the variance provides equal or greater conservation benefit, and does not result in effects that were not analyzed during consultation. Minor variance requests must be documented (e.g., Project Notification Form) and include the following information:

1. cite the restoration activity and the design feature that needs variance
2. define the requested variance
3. explain why the variance is necessary
4. provide a rationale why the variance will either provide a conservation benefit or, at a minimum, not cause additional adverse effects

Variances that do not result in an effect to listed salmonids (i.e., following or not following a minimization measure would have no effect positive or negative) would be documented as such in the project record (Appendix F-2 of the BA).

Project Implementation

All projects that fall under the WFR Program would not be implemented until the NEPA process has been completed and a decision signed by the SRNF, or as indicated in the multi-year NEPA proposed action description. Any ground disturbing project with the potential to generate sediment would not be implemented on the ground until a letter from the North Coast Water Quality Board has been received stating the project was compliant with the Waiver and therefore, meets the CWA. Implementation of the project would be accomplished through a myriad of means depending on the scope and scale of the project including partnerships, contracting or Forest Service personnel.

All contracts and agreements would have the project appropriate general aquatic conservation measures and project design features included. Projects require oversight by Forest Service biologists or hydrologists to insure actions are carried out as planned, and to coordinate efforts in the event of unexpected situations. However, the level of oversight in any one project is commensurate with the potential or increased risk of negative effects occurring to listed salmonids and water quality.

Project/Program Monitoring and Reporting

The SRNF will monitor projects implemented under the WFR Program as part of existing requirements to report on Forest accomplishments and monitoring efforts. In order to monitor the effects, both positive and negative, to the protected ESUs, DPSs and critical habitats over the life of the WFR Program, and to track incidental take of listed species, the Forest would share existing monitoring report/accomplishment tracking processes with NMFS at the Level 1 Annual Coordination meeting and through official correspondence, see Appendix D in the BA (USDA SRNF 2015) for additional information on monitoring. These reports include:

Annual Level 1 Coordination Meeting – as described in the Local Operating Guidelines and above, the annual Level 1 meeting would review projects accomplished the previous year and those proposed in the upcoming year.

Quality Assurance Protection Plan and Annual Reports – required by (North Coast Water Quality Control Board) and include BMP Effectiveness Program (BMPEP) monitoring as well as other water quality monitoring results.

Watershed Improvement Tracking – Annual geo-referenced accomplishment reporting system of stream miles improved, roads decommissioned, or any other actions done to benefit watershed and aquatic ecosystems.

Northwest Forest Plan Aquatic and Riparian Monitoring Program Reports – this monitoring program is at the scale of the Northwest Forest Plan/Range of the Northern Spotted Owl and is designed to track changes due to implementation of the Aquatic Conservation Strategy Objectives.

Project Activities and Design Criteria

Watershed and Aquatic Restoration projects are designed to reduce existing threats and stresses to listed salmonids while avoiding or minimizing any potential long or short-term negative impacts. The SONCC Coho Salmon Recovery Plan, and the Multispecies Recovery Plan for NC steelhead and CC Chinook salmon, in conjunction with the USFS Watershed Condition Framework and local knowledge, will be used to prioritize projects implemented under this Program. Projects would be implemented based on completed NEPA decisions and available funding.

This section identifies the **General Aquatic Conservation Measures (GACM**) that are intended to minimize effects to the aquatic environment followed by the activity specific **Project Design Criteria (PDC)** that are specific to the identified watershed and aquatic restoration activities. The GACM and PDC were developed to minimize adverse effects to the aquatic environment and listed fish and their designated critical habitat as well as MSA habitats. These Design Criteria may be supplemented by the most recent version of California Department of Fish and Wildlife's Fisheries Restoration Grant Program minimization measures.

General Aquatic Conservation Measures

Technical Skill and Planning Requirements

1. Ensure that an experienced fisheries biologist or hydrologist is involved in the design of all projects covered by the WFR Program. The experience should be commensurate with technical requirements of a project.
2. Planning and design includes field evaluations and site-specific surveys, which may include reference reach evaluations that describe the appropriate geomorphic context in which to design and implement the project. Planning and design involves appropriate expertise from staff or experienced technicians (e.g., fisheries biologist, hydrologist, geomorphologist, wildlife biologist, botanist, engineer, silviculturist.)
3. Review current restoration manuals (e.g., CDFW restoration manual available on line: www.dfg.ca.gov/fish/resources/habitatmanual.asp) and literature for best available information and monitoring results on restoration techniques.
4. Best Management Practices will be implemented on a site-specific basis during project-level NEPA. The appropriate BMPs necessary to protect or improve water quality and the methods and techniques of implementing the BMPs are identified at the time of this on-site, project-specific assessment. BMPs will be incorporated into implementation documents.

5. The project fisheries biologist/hydrologist will ensure that project design criteria are incorporated into implementation contracts. If a biologist or hydrologist is not the Contracting Officers Representative (COR), then the biologist or hydrologist must regularly coordinate with the project COR to ensure the project design criteria and conservation measures are being followed.

Resource Surveys

Fisheries, Hydrology, Geomorphology, Wildlife, Botany, and Cultural surveys are those in support of Aquatic Restoration and include assessments and monitoring projects that could or are associated with planning, implementation, and monitoring of aquatic restoration projects covered by the WFR Program. Such support projects may include surveys to document the following aquatic and riparian attributes: fish habitat, hydrology, channel geomorphology, water quality, fish spawning, fish presence, macro invertebrates, riparian vegetation, wildlife, and cultural resources. This also includes effectiveness monitoring associated with projects implemented under this BO.

1. Train resource personnel in survey methods to prevent or minimize disturbance of fish when survey protocols occur adjacent to occupied habitat.
2. Avoid impacts to fish redds.
3. Coordinate with other local agencies to prevent redundant surveys.

Work Periods/Timing

Sediment: Individual projects with the potential to generate sediment under the WFR Program will typically be implemented annually during the Normal Operating Season (between June 15 and November 1[2]) or first significant rainfall, whichever comes first. Actual project start and end dates are based on weather predictions and rainfall predictions. The work window can be extended to November 15 contingent on appropriate dry weather conditions and stream flows. If heavy equipment is proposed to enter the wetted channel, the work period will be limited to June 30 through October 15 to avoid or minimize exposure of adult and YOY life stages. Extensions will be initiated on an as needed basis and as agreed upon by NMFS as documented on the Notification Form.

SRNF will monitor weather and stream flows during fall months, using all appropriate tools, such as the fall, low flow season emails and phone calls with National Weather Service. Projects will end early if needed.

Site Assessment for Contaminants

In developed or previously developed sites, such as areas with past dredge mines, or illegal marijuana cleanup locations, a site assessment for contaminants will be conducted on projects that involve excavation of > 20 cubic yards of material where in proximity to salmonid habitat. SRNF will complete a site assessment to identify the type, quantity, and extent of any potential contamination.

[2] FRGP instream work period

Site Preparation

The SRNF will prepare sites for construction activities incorporating the following minimization measures:

1. Flagging Sensitive Areas – Prior to construction, critical riparian vegetation areas, wetlands, unstable areas and other sensitive sites will be flagged for equipment avoidance to minimize ground disturbance.
2. Staging Area– Staging areas for storage of vehicles, equipment, and fuels will be established to minimize erosion into or contamination of streams and floodplains.
3. Temporary Erosion Controls – Sediment barriers will be placed prior to construction around sites where significant levels of erosion may enter the stream directly or through road ditches. Temporary erosion controls will be in place before any significant alteration of the project site and will be removed once the site has been stabilized following construction activities.
4. Stockpile Materials **–** Minimize clearing and grubbing activities when preparing staging, project, and or stockpile areas. Any large wood, topsoil, and native channel material displaced by construction will be stockpiled for use during site restoration. Materials used for implementation of aquatic restoration categories (e.g., large wood, boulders, fencing material etc.) may be staged within the 100-year floodplain.
5. Hazard Trees **–**The SRNF has adopted the April 2012 Region 5 USFS document (report #RO-12-01), titled *Hazard Tree Guidelines for Forest Service Facilities and Roads in the Pacific Southwest Region* for all projects containing hazards tree abatement components. Where appropriate, include hazard tree removal (amount and type) in project design. Fell hazard trees within riparian areas when they pose a safety risk on roads or near facilities. If possible, fell trees towards a stream. Keep felled trees on site when needed to meet SRNF coarse woody debris objectives.

Heavy Equipment Use

Heavy equipment will be commensurate with the project and operated in a manner that minimizes adverse effects to the environment (e.g., minimally-sized, low pressure tires, minimal hard turn paths for tracked vehicles, temporary mats or plates within wet areas or sensitive soils). These GACM for using heavy equipment include design features for working in stream, fueling locations, road related activities including water drafting, and considerations for noise (pile driving). The amount of time that heavy equipment is in stream channels, riparian areas, and wetlands will be minimized. During excavation, stockpile native streambed materials above the bankfull elevation, where they cannot reenter the stream, for later use to complete the project.

1. **Work from Top of Bank –** To the extent feasible, heavy equipment will work from the top of the bank, unless work from another location (instream) would result in less habitat disturbance, less floodplain disturbance, and/or better meet WFR Program design criteria.
    a. Use of heavy equipment in the wetted channel will be minimized and only occur after all salmonid species have emerged from the gravels. Heavy equipment will only enter the wetted channel post June 30 in order to protect late hatching steelhead fry.
2. **Fueling, Cleaning and Inspection for Petroleum Products and Invasive Weeds**
    a. All equipment used near or instream will be cleaned for petroleum accumulations,

dirt, plant material (to prevent the spread of noxious weeds), and leaks repaired prior to entering the project area. Such equipment includes large machinery, stationary power equipment (e.g., generators, canes, etc.), and gas-powered equipment with tanks larger than five gallons.

    b. Store and fuel equipment in staging areas away from streams after daily use.
    c. Inspect heavy equipment daily for fluid leaks before leaving the staging area.
    d. Thoroughly clean equipment before operation instream or within 50 feet of any natural water body or areas that drain directly to streams or wetlands and as often as necessary during operation to remain grease free.
    e. List and describe any hazardous material that would be used at the project site, including specific clean-up and disposal instructions for different products available on the site; proposed methods for disposal of spilled material; and employee training for spill containment.

3. **Temporary Access Roads –** Existing roadways or travel paths will be used whenever possible. The number of temporary access roads will be minimized to lessen soil disturbance and compaction and impacts to vegetation.
    a. Temporary access roads will not be built on slopes where grade, soil, or other features suggest a likelihood of excessive erosion or failure.
    b. Temporary access roads will be obliterated and/or revegetated.
    c. Temporary roads in wet or flooded areas will be restored by the end of the applicable in-water work period.
    d. Construction of new permanent roads is not permitted.
4. **Stream Crossings –** The number and length of stream crossings will be minimized. Such crossings will be at right angles and avoid potential spawning areas to the greatest extent possible. Stream crossings shall not increase the risk of channel re-routing at low and high water conditions. After project completion, temporary stream crossings will be abandoned and the stream channel and banks restored.
5. **Water Drafting -** Water drafting will occur at existing water drafting sites (locations are shown on maps in Appendix A in the BA). The design features below will be implemented to minimize effects of water drafting on sediment and aquatic species including the following:
    a. draft water only at designated water drafting sites and no modification/improvement of drafting sites in occupied salmonid habitat would occur
    b. coordinate with SRNF fisheries biologists so effects to thermal refugia, fish holding areas, or spawning habitat are avoided;
    c. Water drafting by more than one truck shall not occur simultaneously
    d. Rock and gravel will be applied to drafting sites if it is needed to prevent stream sedimentation, including rocking the approach to prevent sedimentation. Water drafting sites located in non-fish-bearing waters only may include minor instream modification,
    e. When drafting from waters designated as salmonid designated critical habitat, implement NMFS Water Drafting Specifications (NMFS 2001b) and implement Forest Service BMPs outside of critical habitat.
        i. Intakes will be screened with 3/32” mesh for rounded or square openings, or 1/16” mesh for slotted openings. When in habitat potentially occupied

by steelhead, intakes will be screened with 1/8” mesh size. Wetted surface area of the screen or fish-exclusion device shall be proportional to the pump rate to ensure that water velocity at the screen surface does not exceed 0.33 feet/second.

ii. Fish screen will be placed parallel to flow.

iii. Pumping rate will not exceed 350 gallons-per-minute or 10% of the flow of the anadromous stream drafted from.

iv. Pumping will be terminated when tank is full.

Ensuring Fish Passage during Restoration Activities

Fish passage will be provided for any adult or juvenile fish likely to be present in the action area during instream construction, unless passage did not exist before construction, stream isolation and dewatering is required during project implementation (below), or where the stream reach is naturally impassible at the time of construction. After construction, adult and juvenile passage that meets NMFS’s fish passage criteria (NMFS 2011a) will be provided for the life of the action. See Activity-specific design features below.

Fish Handling - Work Area Isolation & Fish Capture and Release

When activities occur in occupied habitat and the SRNF determines that removing listed salmonids would reduce the effects of project implementation, then the Forest will isolate the construction area and remove fish from a project site. The need for instream work isolation and fish handling would be identified at the Level 1 Annual Coordination Meeting and would typically include fish passage projects and activities that would occur within the entire channel width (such as Legacy Structure Removal; and any log or boulder full spanning weir construction).

Few projects of the scale that would require site isolation and fish relocation are anticipated under this WFR Program, and these projects would likely require grant funding. Most funding sources (NOAA, CDFW) typically have their own requirements for fish capture and release, including electrofishing guidelines. The SRNF identified a maximum of one fish handling effort for three populations of SONCC coho salmon per year: Smith River, Middle Klamath River, and Lower Trinity River, and a maximum of one fish handling effort per year for three populations of NC steelhead: Mad River, NF Eel River, and Van Duzen River for the duration of this Program.

Dewatering Construction Site – Fish bearing locations

When dewatering is necessary to protect listed salmonids and/or critical habitat, flow will be diverted around the construction site with a coffer dam (built with non-erosive materials) and an associated pump, a by-pass culvert, or a water-proof lined diversion ditch. Diversion sandbags can be filled with material mined from the floodplain as long as such material is replaced at end of project. Small amounts of instream material can be moved to help seal and secure diversion structures. Flow energy will be dissipated at the bypass outflow to prevent damage to riparian vegetation or the stream channel. If the diversion allows for downstream fish passage, the diversion outlet will be placed in a location to promote safe reentry of fish into the stream channel, preferably into pool habitat with cover. When necessary, seepage water from the de-watered work area will be pumped to a temporary storage and treatment site or into upland areas and allow water to filter through vegetation prior to reentering the stream channel.

1. For the dewatering of a work site a fish screen must be used on the pump intake to avoid juvenile fish entrainment that meets criteria specified by NMFS (2011a, or most recent version).
2. Stream Re-watering – Upon project completion, the construction site will be slowly re-watered to prevent loss of surface water downstream as the construction site streambed absorbs water, and to prevent a sudden increase in stream turbidity. Downstream conditions will be monitored during re-watering to prevent stranding of aquatic organisms below the construction site.

Site Restoration

Upon project completion, all disturbed areas will be rehabilitated such that the site is left in similar or better than pre-work conditions through removal of project related waste, spreading of stockpiled materials (soil, large wood, trees, etc.) seeding, and/or planting with local native seed mixes or plants.

1. Short-term Stabilization – Measures may include the use of non-native sterile seed mix (when native seeds are not available), weed-free certified straw, jute matting, and other similar techniques. Short-term stabilization measures will be maintained until permanent erosion control measures are effective. Stabilization measures will be instigated within three days of construction completion.
2. Revegetation – Each area requiring vegetation will be re-planted prior to or at the beginning of the first growing season following construction activities. Achieve re-establishment of vegetation in disturbed areas to at least 70 percent of pre-project levels within three years. An appropriate mix of species will be used that will achieve establishment and erosion control objectives, preferably forb, grass, shrub, or tree species native to the project area or region and appropriate to the site. All riparian plantings shall use native plants as approved by the Forest Botanist. Barriers will be installed as necessary to prevent access to revegetated sites by livestock or unauthorized persons.
3. Decompact Soils – When necessary, loosen compacted areas, such as access roads and paths, stream crossings, staging, and stockpile areas to better allow for reestablishment of vegetation.

Monitoring

Project specific monitoring would be outlined during project level NEPA analysis, or during the Level 1 Annual Coordination Meeting. Monitoring may include the following:

1. **Implementation Monitoring:**
   a. Visually monitor during project implementation to ensure effects are not greater (amount, extent) than anticipated and to contact Level 1 representatives if problems arise.
   b. Fix any problems that arise during project implementation.
   c. Regular biologist/hydrologist coordination with SRNF Contracting Officer Representative (COR) if biologist/hydrologist is not always on site to ensure contractor is following all stipulations.
   d. **Water Quality Checklists** for Category B type projects covered under the Waiver issued to the SRNF by the Water Quality Control Board.

e. **Fish Mortality during Project Implementation** - If a sick, injured, or dead specimen of a threatened or endangered species is found in the project area, the finder must notify NMFS through the contact person identified in the transmittal letter for this opinion and follow any instructions given by the NMFS contact.

2. **Post Project or Effectiveness Monitoring –** For those projects identified during the Level 1 Annual Coordination Meeting, a post-project review shall be conducted after winter and spring high flows as identified on the Project Tracking Form.
   a. For each project, conduct a walk through/visual observation to determine if there are post-project effects that were not considered during consultation.
   b. In cases where remedial action is required, such actions are permitted without additional consultation if the effects of Program activities on listed fish have not been exceeded.

Activity Specific Project Information

Fish Access to Habitat/ Habitat Connectivity

Road Related Fish Passage

Based on the location of the Forest road system, there are no known road crossings that are preventing salmonid migration upstream, however, barriers may exist on private land that could be addressed under the Wyden Agreement. Potential actions include:

- total removal of culverts or bridges, or replacing culverts or bridges with properly sized culverts and bridges, replacing a damaged culvert or bridge, and resetting an existing culvert that was improperly installed or damaged;
- stabilizing and providing passage over headcuts;
- removing, constructing (including relocations), repairing, or maintaining fish ladders; and replacing, relocating, or constructing fish screens and diversions;
- gradient control weirs upstream or downstream of barriers to control water velocity, water surface elevation, or provide sufficient pool habitat to facilitate jumps, or
- interior baffles or weirs to mediate velocity and the increased water depth.

Other Passage Activities

Natural barriers (i.e. boulder barriers that move during high flows) exist that in the past have allowed for salmon and steelhead passage would be considered for improvement. Modifying partial barriers formed by previously constructed instream structures are described below under "*Existing or Legacy Structure Improvements or Removal.*" Barrier modification projects are intended to improve passage by:

- providing or improving access to refugia during summer months,
- increasing the duration of accessibility (both within and between years).
- improving low flow barriers and log jam modifications to facilitate juvenile and adult fish passage, including at existing/historic instream restoration sites.

Habitat Connectivity

In addition to barriers to fish migration up and down stream, restoration activities reconnect stream corridors and allow the downstream movement of wood, macro invertebrates and other necessary components of a healthy stream system. This activity is primarily accomplished through culvert removal during decommissioning and to some extent, upgrading culverts during road maintenance.

Implementing these types of projects may require the use of heavy equipment (*e.g.*, self-propelled logging yarders, mechanical excavators, backhoes); however, hand labor will be used when possible.

Design Features

- See NMFS Fish Passage guidance
- Fish Xing software is consulted

Instream habitat enhancement

Projects that increase instream cover and complexity for juvenile survival and spawning success are intended to provide predator escape and resting cover, increase spawning and rearing habitat, improve migration corridors, improve pool to riffle ratios, and add habitat complexity and diversity. Specific techniques for instream habitat improvement include:

- Placing large woody debris (LW) in the stream channel to enhance pool formation and increase stream channel complexity. Projects will include both anchored (engineered log jams) and unanchored logs, depending on site conditions and wood availability. LW placed in streams without cabling would allow for natural distribution of wood in the channel. LW sources are described below.
- Placing new boulders in stream channel to provide cover and scour opportunities (boulder clusters, deflectors).
- Maintaining and improving historic instream enhancement sites through reconstruction or addition of LW. This could include:
- Addressing low flow barriers in old weirs by adding low flow notches or reconfiguring boulders or logs.
- Placement of imported spawning gravel.
- Restoration of habitat to support beaver populations to aid in continued development of complex salmonid habitat.

These projects will occur in stream channels and adjacent floodplains to increase channel stability, rearing habitat, pool formation, spawning gravel deposition, channel complexity, hiding cover, low velocity areas, and floodplain function. Equipment such as helicopters, excavators, dump trucks, front-end loaders, full-suspension yarders may be used to implement projects.

Large Wood and Boulder Projects

Sources of Trees for Instream Work

Large wood could come from existing riparian wood sources such as spanner logs dropped into the stream channel, moving downed LW from adjacent riparian areas, cutting and falling individual trees into the channel. In addition, live conifers and other trees can be felled or pulled/pushed over in the riparian area and upland areas for in-channel large wood placement only when conifers and trees are fully stocked. Fully stocked means that there are sufficient standing trees such that individually selected trees could be cut or pulled over (for the root wad) without affecting the stand characteristics, including canopy cover. Tree felling for LW sources would not create excessive stream bank erosion or increase the likelihood of channel avulsion during high flows. Canopy cover would not be reduced based on individual tree selection from riparian areas. Specific techniques include:

- Large wood could also come from off-site sources and be brought in via trucks or helicopters.
- Hazard trees and trees killed through fire, insects, disease, blow-down and other means can be felled and used for in-channel placement regardless of live-tree stocking levels.
- Trees from other management activities may be stock piled for future instream restoration projects. The removal and stockpiling of these trees would be analyzed under a separate program level or project level consultation.
- Downed trees from clearings made for illegal marijuana grows.

Design Features

1. Place LW and boulders in areas where they would naturally occur and in a manner that closely mimic natural accumulations for that particular stream type. For example, boulder placement may not be appropriate in low-gradient meadow streams.
2. Structure types shall simulate disturbance events to the greatest degree possible and include, but are not limited to, log jams (see engineered log jams below), debris flows, wind-throw, and tree breakage.
3. No limits are to be placed on the size or shape of structures as long as such structures are within the range of natural variability of a given location and do not block fish passage.
4. The partial burial of LW and boulders is permitted and may constitute the dominant means of placement. This applies to all stream systems but more so for larger stream systems where use of adjacent riparian trees or channel features is not feasible or does not provide the full stability desired.
5. LW includes whole conifer and hardwood trees, logs, and rootwads. LW size (diameter and length) should account for bankfull width and stream discharge rates. When available, trees 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 channel width.
6. Structures may partially or completely span stream channels or be positioned along stream banks (see engineered log jams and boulder weirs for additional design features).
7. Stabilizing or key pieces of LW must be intact, hard, with little decay, and if possible have root wads (untrimmed) to provide functional refugia habitat for fish. Consider orienting key pieces such that the hydraulic forces upon the large wood increases stability.
8. Anchoring Large Wood – Anchoring alternatives may be used in preferential order:
    a. use of adequate sized wood sufficient for stability
    b. orient and place wood in such a way that movement is limited
    c. ballast (gravel and/or rock) to increase the mass of the structure to resist movement
    d. use of large boulders as anchor points for the LW
    e. Pin LW with rebar to large rock to increase its weight. For streams that are entrenched or for other streams with very low width to depth ratios (<12) an

additional 60% ballast weight may be necessary due to greater flow depths and higher velocities.

Engineered Log jam (ELJs)

These are structures designed to redirect flow and change scour and deposition patterns. To the extent practical, they are patterned after stable natural log jams and can be either unanchored or anchored in place using rebar, rock, or piles. These log jams create a hydraulic shadow, a low-velocity zone downstream that allows sediment to settle out. Scour holes develop adjacent to the log jam. While providing valuable fish and wildlife habitat they also redirect flow and can provide stability to a streambank or downstream gravel bar. Designing these projects will require an interdisciplinary team of biologists, hydrologists, geologists and engineers. Specific techniques include:

- ELJs will be patterned, to the greatest degree possible, after stable natural log jams.
- Grade control ELJs are designed to arrest channel downcutting or incision by providing a grade control that retains sediment, lowers stream energy, and increases water elevations to reconnect floodplain habitat and diffuse downstream flood peaks.
- Stabilizing or key pieces of LW that will be relied on to provide streambank stability or redirect flows must be intact, solid (little decay). If possible, acquire LW with untrimmed rootwads to provide functional refugia habitat for fish.
- When available, trees with rootwads attached should be a minimum length of 1.5 times the bankfull channel width, while logs without rootwads should be a minimum of 2.0 times the bankfull width.
- The partial burial of LW and boulders may constitute the dominant means of placement, and key boulders (footings) or LW can be buried into the stream bank or channel
- Angle and Offset – The LW portions of engineered log jam structures should be oriented such that the forces upon the large wood increases stability. If a rootwad is left exposed to the flow, the bole placed into the streambank should be oriented downstream parallel to the flow direction so the pressure on the rootwad pushes the bole into the streambank and bed. Wood members that are oriented parallel to flow are more stable than members oriented at 45 or 90 degrees to the flow.
- If LW anchoring is required, a variety of methods may be used. These include buttressing the wood between riparian trees, the use of manila, sisal or other biodegradable ropes for lashing connections. If hydraulic conditions warrant use of structural connections, such as rebar pinning or bolted connections, may be used. Rock may be used for ballast but is limited to that needed to anchor the LW.

Boulder Weirs

Full channel spanning boulder weirs are to be installed only in highly uniform, incised, bedrock-dominated channels to enhance or provide fish habitat in stream reaches where log placements are not practicable due to channel conditions (not feasible to place logs of sufficient length, bedrock dominated channels, deeply incised channels, artificially constrained reaches, etc.), where damage to infrastructure on public or private lands is of concern, or where private landowners will not allow log placements due to concerns about damage to their streambanks or property. Specific techniques include:

- Install boulder weirs low in relation to channel dimensions so that they are completely overtopped during channel-forming flow events (approximately a 1.5-year flow event).
- Boulder weirs are to be placed diagonally across the channel or in more traditional upstream pointing “V” or “U” configurations with the apex oriented upstream.
- Boulder weirs are to be constructed to allow upstream and downstream passage of all native fish species and life stages that occur in the stream. Plunges shall be kept less than 6 inches in height.
- The use of gabions, cable, or other means to prevent the movement of individual boulders in a boulder weir is not allowed.
- Rock for boulder weirs shall be durable and of suitable quality to assure long-term stability in the climate in which it is to be used. Rock sizing depends on the size of the stream, maximum depth of flow, planform, entrenchment, and ice and debris loading.
- The project designer or an inspector experienced in these structures would be present during installation.
- Full spanning boulder weir placement would be coupled with measures to improve habitat complexity and protection of riparian areas to provide long-term inputs of LW.

Gravel Augmentation

Design Features

- Gravel can be placed directly into the stream channel, at tributary junctions, or other areas in a manner that mimics natural debris flows and erosion.
- Augmentation will only occur in areas where the natural supply has been eliminated, significantly reduced through anthropogenic disruptions, or used to initiate gravel accumulations in conjunction with other projects, such as simulated log jams and debris flows.
- Gravel to be placed in streams shall be a properly sized gradation for that stream, clean, and non-angular. When possible use gravel of the same lithology as found in the watershed. Reference the *Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings* to determine gravel sizes appropriate for the stream. This manual can be found at the following location: http://stream.fs.fed.us/fishxing/aop_pdfs.html
- Gravel can be mined from the floodplain at elevations above bankfull. Crushed rock is not permitted.
- After gravel placement in areas accessible to higher stream flow, allow the stream to naturally sort and distribute the material.
- Do not place gravel 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.
- Imported gravel must be free of invasive species and non-native seeds. If necessary, wash gravel prior to placement.

Existing or Legacy Structure Improvements or Removal

Projects will be implemented to reconnect stream corridors, floodplains, and estuaries, reestablish wetlands, improve aquatic organism passage, and restore more natural channel and flow conditions. This includes removal or modifying channel-spanning weirs and existing habitat structures as needed to restore fish passage and improve instream conditions. Projects involving earthen embankments, subsurface drainage features, outfalls, pipes, instream flow redirection structures (e.g., drop structure, gabion, groin), or similar devices used to control, discharge, or maintain water levels would be improved. These existing water diversions are operated through special use permits. Equipment such as excavators, bull dozers, dump trucks, front-end loaders, and similar equipment may be used to implement projects.

Improvement of Legacy Structures Design Features

This action includes modification of past projects and includes adding components to exiting locations and modifying those legacy structures that are no longer functioning properly (i.e., log weirs that have undercut and may be a low flow barrier to juvenile salmonids). Design criteria for instream structure work as described above would apply to modification.

Water diversions on the SRNF typically are a result of a Special Use Permit for the infrastructure crossing Forest Service lands. Improvements to these historic diversion sites could result in decreased impacts to water quality and potentially water quantity. No new diversions would be approved under this WFR Program.

1. Diversion structures must pass all life stages of T&E aquatic species that historically used the affected aquatic habitat.
2. Diversions that involve setting minimum flows that could affect fish movement or cool water refugia may be outside the scope of this consultation as determined during project notification at the Level 1 Annual Coordination Meeting.
3. Water diversion intake and return points must be designed to prevent all native fish life stages from swimming or being entrained into the diversion. Apply NMFS fish screen criteria in anadromous salmonid habitat.
4. Abandoned ditches and other similar structures will be plugged or backfilled, as appropriate, to prevent fish from swimming or being entrained into them.
5. When making improvements to pressurized diversions, install a totalizing flow meter capable of measuring rate and duty of water use. For non-pressurized systems, install a staff gage or other measuring device capable of measuring instantaneous rate of water flow.
6. Multiple existing diversions may be consolidated into one diversion as long as there is new instream construction or structures and if the consolidated diversion is located at the most downstream existing barrier.
7. Conversion of instream diversions to groundwater wells will only be used in circumstances where there is an agreement to ensure that any surface water made available for instream flows is protected from surface withdrawal by another water-user.

Removal of Legacy Structure Design Features

This action includes the removal of legacy instream structures, such as large wood, boulder, rock gabions, and other in-channel and floodplain structures that were installed on the SRNF in the past, but are not serving to improve salmonid habitat. The following design features apply:

- If the structure being removed contains material (i.e., large wood, boulders, etc.) not typically found within the stream or floodplain at that site, remove material from the 100-year floodplain.
- If the structure being removed contains material (i.e., large wood, boulders, etc.) that is typically found within the stream or floodplain at that site, the material can be reused to

implement habitat improvements described under Large Wood, Boulder, and Gravel Placement activity category in this Program.

- If the structure being removed is keyed into the bank, fill in "key" holes with native materials to restore contours of stream bank and floodplain. Compact the fill material adequately to prevent washing out of the soil during over-bank flooding. Do not mine material from the stream channel to fill in "key" holes.
- When removal of buried log structures may result in significant disruption to riparian vegetation and/or the floodplain, consider using a chainsaw to extract the portion of log within the channel and leaving the buried sections within the streambank.
- If the legacy structures (log, rock, or gabion weirs) were placed to provide grade control, evaluate the site for potential headcutting and incision due to structure removal. If headcutting and channel incision are likely to occur due to structure removal, additional measures must be taken to reduce these impacts.

Beaver Habitat Restoration

This action includes installation of in-channel structures to encourage beavers to build dams in incised channels and across potential floodplain surfaces. The dams are expected to entrain substrate, aggrade the bottom, and reconnect the stream to the floodplain. Like natural beaver dams, these beaver dam analogs [aka beaver dam support (BDS) structures or post assisted woody structures (PAWS)] are temporary features on the landscape. These structures are intended to aid in the development of beaver dams where beavers are already present. Multiple placements of these analogs are important to increase the overall stream resilience and not count on any one resulting dam to provide habitat improvement (Pollock et al. 2015). Most work would be accomplished by hand; however use of equipment such as excavators, bull dozers, dump trucks, front-end loaders, and similar equipment may be used to implement projects.

Design Features

1. Determine suitability of site for beaver habitat restoration through coordination with CDFW and review of site selection criteria (biological, political, social) such as developed in the 2015 Beaver Restoration Guidebook (Pollock et al., 2015) or the "Beaver Tool Box" located here: www.martinezbeavers.org.

In-channel structures

   a. Placement of posts in channel to aid in the creation of beaver dams. Posts may be driven into the stream channel using heavy equipment or through the use of a hydrologic post hole digger.
   b. Consist of porous channel-spanning structures comprised of biodegradable vertical posts (BDS or PAWS) approximately 0.5 to 1 meter apart and at a height intended to act as the crest elevation of an active beaver dam. Variation of this restoration treatment may include post lines only, post lines with wicker weaves, construction of starter dams, reinforcement of existing active beaver dams, and reinforcement of abandoned beaver dams (Pollock et al. 2015).
   c. Provide for fish passage, both adult and juvenile life stages in managing beaver instream habitat with structures by
      i. Placing structures in a low gradient area so that during higher flows when adult salmonids are moving there are side channels and over topping flows that provide channels for passage

ii. During long periods of low flows during the winter when fish are moving, ensure diligent monitoring of the structure and the ability to break out a section of the willow to allow passage, if needed.

d. Place BDS structures in areas conducive to dam construction as determined by stream gradient and/or historical beaver use.
e. Place in areas with sufficient deciduous shrub and trees to promote sustained beaver occupancy.

Habitat Restoration

a. Drainages historically occupied by beaver, but which may be currently unsuitable for relocations, may require management for improvement and recovery. Restoration activities may include planting riparian hardwoods (species such as willow, red osier dogwood, and alder) and building enclosures (such as temporary fences) to protect and enhance existing or planted riparian hardwoods until they are established.
b. Maintain or develop grazing plans that will ensure the success of beaver habitat restoration objectives.

Side Channel/Off Channel Rearing Habitat

Projects will be implemented to reconnect historic side-channels with floodplains by removing off-channel fill and plugs. In addition, new side-channels and alcoves can be constructed in geomorphic settings that will accommodate such features. This activity category typically applies to areas where side channels, alcoves, and other backwater habitats have been filled or blocked from the main channel, disconnecting them from most, if not all flow events. These project types will increase habitat diversity and complexity, improve flow heterogeneity, provide long-term nutrient storage and substrate for aquatic macroinvertebrates, moderate flow disturbances, increase retention of leaf litter, and provide refuge for fish during high flows. Types of side channel or off-channel restoration projects include:

- connecting of abandoned side channel, pond habitats or remnant oxbows to restore fish access,
- creating of side channel or off-channel habitat with self-sustaining channels, and
- improving hydrologic connection between floodplains and main channels.

Restoration projects in this category may include: channel and pond excavation, creating temporary access roads, constructing wood or rock tailwater control structures, removal or breaching of levees and dikes, and construction of LW habitat features.

Implementation of these types of projects may require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes).

Design Features

- Allowable Excavation – Off- and side-channel improvements can include minor excavation (< 10% of volume) of naturally accumulated sediment within historical channels. There is no limit as to the amount of excavation of anthropogenic fill within historic side channels as long as such channels can be clearly identified through field and/or aerial photographs. Excavation depth will not exceed the maximum thalweg depth in the main channel.

- Excavated material removed from off- or side-channels shall be hauled to an upland site or spread across the adjacent floodplain in a manner that does not restrict floodplain capacity.

Streambank Restoration and Enhancement

The SRNF will improve streambank condition by stabilizing stream banks with appropriate site-specific techniques. Objectives of streambank stabilization include reduction of streambank sediment input to improve fish habitat and fish survival by increasing fish embryo and alevin survival in spawning gravels, and minimizing the loss of, or reduction in size of, pools from excess sediment deposition. The proposed activities will reduce stream sedimentation from bank erosion by:

- stabilizing stream banks by use of boulder, log and native plant structures,
- reducing recreation impacts associate with stream access points,
- constructing livestock barriers and improving water sources to limit livestock access to stream banks.

Implementation of these types of projects could require the use of heavy equipment (*e.g.* mechanical excavators, backhoes) with hand tools (including chainsaws) used when possible. Projects will be implemented through bank shaping and installation of coir logs or other soil reinforcements as necessary to support riparian vegetation; planting or installing large wood, trees, shrubs, and herbaceous cover as necessary to restore ecological function in riparian and floodplain habitats; or a combination of the above methods. Such actions are intended to restore banks that have been altered through road construction, improper grazing, invasive plants, etc.

Streambank Restoration Design Features

- Without changing the location of the bank toe, restore damaged streambanks to a natural slope and profile suitable for establishment of riparian vegetation. This may include sloping of unconsolidated bank material to a stable angle of repose or the use of benches in consolidated, cohesive soils.
- Complete all soil reinforcement earthwork and excavation in the dry season. When necessary, use soil layers or lifts that are strengthened with biodegradable fabrics and penetrable by plant roots.
- Include large wood to the extent it would naturally occur. If possible, large wood should have untrimmed root wads to provide functional refugia habitat for fish. Wood that is already within the stream or suspended over the stream may be repositioned to allow for greater interaction with the stream.
- 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, stream channels, etc.
- Install fencing as necessary to prevent access to revegetated sites by livestock or unauthorized persons.
- Conduct post-construction monitoring and treatment or removal of invasive plants until native plant species are well established.

Reduction/Relocation of Recreation Impacts

These projects are intended to close, better control, or relocate recreation infrastructure and use along streams and within riparian areas. This includes removal, improvement, or relocation of infrastructure associated with designated campgrounds, dispersed camp sites, day-use sites, foot trails, and off-road vehicle (ORV) roads/trails in riparian areas. The primary purpose is to eliminate or reduce recreational impacts to restore riparian areas and vegetation, improve bank stability, and reduce sedimentation into adjacent streams. Equipment such as excavators, bull dozers, dump trucks, front-end loaders, and similar equipment may be used to implement projects.

Design Features

- For existing recreation facilities within riparian areas, evaluate and mitigate impact to ensure that these do not prevent, and to the extent practicable contribute to, attainment of aquatic conservation objectives.
- Adjust dispersed and developed recreation practices that retard or prevent attainment of aquatic conservation objectives. Where adjustment measures such as education, use limitations, traffic control devices, increased maintenance, relocation of facilities, and/or specific site closures are not effective, eliminate the practice or occupancy.
- Design actions to restore floodplain characteristics—elevation, width, gradient, length, and roughness—in a manner that closely mimics, to the extent possible, those that would naturally occur at that stream and valley type.
- To the extent possible, non-native fill material shall be removed from the floodplain to an upland site.
- Overburden or fill comprised of native materials, which originated from the project area, can be used to reshape the floodplain, placed in small mounds on the floodplain, used to fill anthropogenic holes, buried on site, and/or disposed into upland areas.
- For recreation relocation projects—such as campgrounds, dispersed sites, off road vehicle (ORV) trails—move current facilities out of the riparian area or as far away from the stream as possible.
- Consider de-compaction of soils and vegetation planting once overburden material is removed.
- Place barriers—boulders, fences, gates, etc.—outside of the bankfull width and across traffic routes to prevent ORV access into and across streams.
- For work conducted on ORV roads and trails, follow relevant PDC in the Road and Trail Erosion Control and Decommissioning category

Livestock Fencing, Stream Crossings and Off-Channel Livestock Watering Facilities

These projects will be implemented by constructing fences to exclude riparian grazing, providing controlled access for walkways that livestock use to transit across streams and through riparian areas, and reducing livestock use in riparian areas and stream channels by providing upslope water facilities. Such projects promote a balanced approach to livestock use in riparian areas, reducing livestock impacts to riparian soils and vegetation, streambanks, channel substrates, and water quality. Equipment such as excavators, bull dozers, dump trucks, front-end loaders, and similar equipment may be used to implement projects.

Design Features

1. Livestock Fencing
   a. Fence placement should allow for lateral movement of a stream and to allow establishment of riparian plant species. To the extent possible, fences will be placed outside the channel migration zone.
   b. Minimize vegetation removal, especially potential large wood recruitment sources, when constructing fence lines.
   c. Where appropriate, construct fences at water gaps in a manner that allows passage of large wood and other debris.
2. Off-channel livestock watering facilities
   a. Water withdrawals must not dewater habitats or cause low stream flow conditions that could affect listed salmonids. Withdrawals may not exceed 10 percent of the available flow.
   b. Surface water intakes must be screened to meet the most recent version of NMFS fish screen criteria and be self-cleaning or regularly maintained by removing debris buildup. A responsible party will be designated to conduct regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning.
   c. Place watering troughs far enough from a stream or surround with a protective surface to prevent mud and sediment delivery to the stream. Avoid steep slopes and areas where compaction or damage could occur to sensitive soils, slopes, or vegetation due to congregating livestock.
   d. Ensure that each livestock water development has a float valve or similar device, a return flow system, a fenced overflow area, or similar means to minimize water withdrawal and potential runoff and erosion.

Riparian Restoration and Enhancement

Improve Riparian Condition by increasing future recruitment of LW to stream. Riparian habitat restoration projects will aid in the restoration of riparian habitat by increasing the number of plants and plant groupings. Riparian projects include:

- Planting native species,
- girdling alders in dense stands to allow natural alder mortality leading to increased sunlight for conifer recruitment,
- removing invasive riparian species, including Himalaya berry.

Riparian Vegetation Planting

Activities may include the following: planting conifers, deciduous trees and shrubs; placement of sedge and or rush mats; gathering and planting willow cuttings. The resulting benefits to the aquatic system can include desired levels of stream shade, bank stability, stream nutrients, large wood inputs, increased grasses, forbs, and shrubs, and reduced soil erosion.

- Experienced silviculturists, botanists and ecologists shall be involved in designing vegetation treatments.
- Species to be planted will be of the same species that naturally occur in the project area. Acquire native seed and/or plant sources as close to the watershed as possible.
- Tree and shrub species, willow cuttings, as well as sedge and rush mats to be used as transplant material shall come from outside the bankfull channel width, typically in terraces

(abandoned flood plains), or where such plants are abundant.

- Sedge and rush mats should be sized to prevent their movement during high flow events.
- Concentrate plantings above the bankfull elevation.
- Removal of small amounts of native and non-native vegetation that will compete with plantings is permitted.

Riparian Vegetation Restoration

This includes actions to accelerate conifer growth in areas where areas were historically conifer dominated. Girdling is a technique used to suppress and then stop the growth of a living tree without felling it among other healthy plants. Using a saw (often a chainsaw), the tree is cut into (i.e., girdled) to cut off the flow of water and food up and down the tree. Girdling forces the tree to become less competitive for sunlight, and gradually the leaves fail to capture sunlight and the plants die standing. Over time, the tree will die and either fall over or degrade in place all the while providing parts of the forest system with something of value (habitat, protection, etc.).

- Experienced silviculturists, botanists or ecologists shall be involved in designing riparian vegetation enhancement projects.
- Minimize number of alders to be girdled while still creating openings to accelerate conifer growth.
- Stagger treatments along stream channels.

Non-native Invasive Plant Control

Manual methods will be used to remove invasive non-native plants within riparian areas or upland locations. This activity is intended to improve the composition, structure, and abundance of native riparian plant communities important for bank stability, stream shading, large wood and other organic inputs into streams, all of which are important elements to fish habitat and water quality. Manual treatments are those done with hand tools or hand held motorized equipment. Vegetation disturbance varies from cutting or mowing to temporarily reduce the size and vigor of plants to removal of entire plants. Soil disturbance is minimized by managing group size and targeting individual plants. Minimization measures include avoiding treatments that create bare soil in large or extensive areas, reseeding and mulching following treatments, and avoiding work when soils are wet and subject to compaction.

Road Actions

The SRNF proposes to reduce delivery of sediment to stream network through upslope watershed restoration projects. Road and trail related actions fall into two main categories:

- Maintaining and upgrading the identified minimum road (and trail) transportation system as determined through travel management plans (see Appendix A-3 in BA, USDA SRNF 2015) to prevent the existing road network from degrading water quality, including the following:
  - upgrading undersized or worn out pipes,
  - storm-proofing by adding rolling dips to prevent diversions at stream crossings,
  - changing road maintenance level (either increase or decrease to meet management objective)
  - closing – road unavailable for vehicle use, make hydrologically maintenance free and

could include installation of gates or placement of boulders or earth berm/vehicle trap to prevent traffic
    - Maintaining and improving ORV and non-motorized trails to reduce sedimentation and could include relocation of recreation sites and improving access at culverts or low water crossings

- Implementing decisions to decommission system roads, trails and unauthorized routes to restore drainage patterns (i.e., removing culvert, re-establish vegetation, re-contour)

Implementation of these types of projects would require the use of heavy equipment (*e.g.* mechanical excavators, backhoes) with hand labor used when possible.

Road Analysis Process

Since 1996, SRNF has been implementing travel management planning to identify the properly sized road system on a watershed or district basis. The ultimate goal is management and sustainability of a road system that minimizes adverse environmental impacts by assuring roads are in locations where they are necessary to meet access needs, and can be maintained within budget constraints. This Program BO updates existing consultation documents done in 2007 for the Smith River National Recreational Area and the Orleans Travel Management efforts.

Culvert and Bridge Projects – Repair and replacement

All road-stream crossing structures shall simulate stream channel conditions per Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings ("Fish Xing"), located at: http://stream.fs.fed.us/fishxing/aop_pdfs.html in conjunction with NMFS fish passage guidelines

Culvert Criteria – Within the considerations of stream simulation, the structure shall, at a minimum, accommodate a bankfull wide channel plus constructed banks to provide for passage of all life stages of native fish species.

- Crossings shall be designed using an interdisciplinary design team consisting of an experienced engineer, fisheries biologist, and hydrologist/geomorphologist and reviewed by the USDA Forest Service Aquatic Organism Passage Design Assistance Team when necessary.
- Bankfull width shall be based on the upper end of the distribution of bankfull width measurements as measured in the reference reach to account for channel variability and dynamics.

Bridge Design/Replacement

- Bridges with vertical abutments—including concrete box culverts, which are constructed as bridges—shall have their stream channels, including width, designed according to culvert guidelines.
- Structure material must be concrete or metal. Concrete must be sufficiently cured or dried before coming into contact with stream flow. The use of treated wood for bridge construction or replacement is not allowed under the WFR Program.

- Riprap must not be placed within the bankfull width of the stream. Riprap may only be placed below bankfull height when necessary for protection of abutments and pilings. However, the amount and placement of riprap should not constrict the bankfull flow.
- Site containment during demolition so concrete wash water or other concrete does not enter stream. When concrete is poured to construct bridge footings or other infrastructure in the vicinity of flowing water, work must be conducted to prevent contact of wet concrete with water (*e.g.*, within a cofferdam). Concrete or concrete slurry will not come into direct contact with flowing water.
- Falsework will be installed to keep bridge debris and construction, maintenance, and repair materials from falling into streams during demolition, construction, and substantial maintenance and repair activities.
- Provides passage for all life stages of native fish

Road and Trail Erosion Control

The following definitions describe activities that would occur within the proposed action. All activities incorporate Standards and Guidelines (S&Gs) Best Management Practice (BMPs) as standard practice. Where applicable, the activities described below include pertinent BMPs.

Road and Trail Maintenance

- Road maintenance - This includes brushing, culvert cleaning, slide removal etc. See Appendix G in the BA for this Program (USDA SRNF 2015) for a complete description of road maintenance descriptions and design features. Some overlap exists with the storm proofing category. Culvert replacement/upgrading in stream channels would also follow the below design criteria.
- Trail maintenance – Actions are similar to maintenance necessary for road maintenance, however, equipment used is based on the allowable use of the trail.

Road Maintenance - Risk Reduction (“Stormproofing”)

- Upgrade culverts for 100 year flood (See Culvert and Bridge Projects section)
- Drainage features used for stormproofing and treatment projects should be spaced as to hydrologically disconnect road surface runoff from stream channels. If grading and resurfacing is required, use gravel, bark, or other permeable materials for resurfacing.
- Minimize disturbance of existing vegetation in ditches and at stream crossings.

Closing Roads

This work is required when a road is managed or downgraded to a low maintenance level and may be accomplished through gating, obliterating take-off, recontouring the take-off, or barring at the road entrance. If earthen barriers are created, they will be treated to avoid erosion into waterways, such as seeding and mulching, as site conditions require. Downgrading is primarily aimed at the reduction of maintenance costs on low-use roads. Downgrading to OML 1 would close the road for vehicle use but would maintain the option of future use.

- Road must be left in hydrological maintenance free state, which typically includes removal of drainage structures.

Road Decommissioning

The SRNF will propose road decommissioning as the appropriate action when the risks to water quality and listed salmonids outweigh the need for the road for long term management and public use, or when unauthorized user created routes need to be restored and use prevented. This decision occurs during the SRNF's Travel Management planning process. Travel analysis has occurred on portions of SRNF and identified roads have been decommissioned (Appendix A-3 of the BA, USDA SRNF 2015). Surveys have or will be completed on remaining portions of the SRNF to determine road condition and risk to water quality in support of the travel management process.

Road decommissioning typically includes the following: 1) outsloping roads at 10% to 30% where necessary to restore natural surface drainage, 2) ripping the roadbed surface to restore infiltration and promote revegetation, 3) seeding, mulching and fertilizing restored areas as needed to control short-term surface erosion and invasive weeds, 4) installing barricades at road take-offs, 5) crushing and/or removal of cross-drain culverts, 6) stabilizing road prism landslides, and 7) removal of stream crossing culverts and associated fill material at a depth to original channel gradient; width to original "canyon" walls or, where not practical, 1.5:1 or flatter side slopes.

Decommissioning roads places them in a maintenance-free condition (culverts and other drainage structures are removed, reestablishing natural drainage patterns), are not drivable by motor vehicle, and are not on the Forest Transportation System. In areas along roads that show signs of road failure due to slope instability, road prisms would be outsloped (sloped towards downhill side of roadway) to improve surface drainage and to reduce the risk of slumps and landslides. In most cases, the road bed will remain intact and provide non-motorized access.

- For road decommissioning and hydrologic closure projects within riparian areas, re-contour the affected area to mimic natural floodplain contours and gradient to the extent possible.
- When obliterating or removing segments adjacent to a stream, use sediment control barriers between the project and stream if applicable for the site and as guided by appropriate BMPs.
- Dispose of slide and waste material in stable sites out of the flood-prone area. Native material may be used to restore natural or near-natural contours.
- Conduct activities during dry-field conditions (generally June 15 to October 15) when the soil is more resistant to compaction and soil moisture is low. See general ACM for Work Period and Wet Weather Operations in Appendix B-3 of the WFR Program BA (USDA SRNF 2015) for the process for determining soil moisture.
- When removing a culvert from a first or second order, non-fishing bearing stream, project specialists shall determine if the culvert removal should include stream isolation and rerouting in project design. Culvert removal on fish bearing streams shall adhere to the measures described in the Fish Access activity.
- For culvert removal projects, restore natural drainage patterns and channel morphology. Evaluate channel incision risk and construct in-channel grade control structures when necessary.

Other Activities

Illegal Marijuana Grow Clean Ups

This includes the cleanup of illegal marijuana grows that have been cleared by law enforcement and pose risk to aquatic ecosystems. Actions included in this activity are:

- Re-establishing stream channels, removing illegal dams from headwater streams
- Restoring access roads – see roads section
- Remove waste products like pipe, tarps, garbage, chemicals products
- Revegetate with native plants
- Consider stockpiling trees illegally cut down during clearing for use in stream enhancement projects

Implementation of these types of projects could require the use of heavy equipment (e.g. mechanical excavators, backhoes) with hand tools (including chainsaws) used when possible. Helicopters could be used to remove waste and transport trees that were illegally cut down.

Mine Tailing Removal/Mine Restoration

The restoration of mines locations include the excavation and removal of mine waste from stream channels, banks, terraces and lower hill slopes; stabilization and re-vegetation of mines and associated waste areas, transportation of waste materials to safe impoundment areas and, capping of impoundments with soil and vegetation.

In-channel Nutrient Enhancement

This includes the placement of salmon carcasses, carcass analogs (i.e., processed fish cakes), or inorganic fertilizers in stream channels to help return stream nutrient levels back to historic levels. This action helps restore marine-derived nutrients to aquatic systems, thereby adding an element to the food chain that is important for growth of macroinvertebrates, juvenile salmonids, and riparian vegetation.

- Coordinate with California Department of Fish and Wildlife on appropriate use.
- Ensure that the relevant streams have the capacity to capture and store placed carcasses.
- Carcasses should be of species native to the watershed and placed during the normal migration and spawning times that would naturally occur in the watershed.
- Do not supplement nutrients in eutrophic or naturally oligotrophic systems.

Application and distribution of nutrients throughout a stream corridor can occur from bridges, stream banks, or helicopter.

Upper Limits on Actions

Table 2 displays the project activities along with the estimation of the number of projects and the type (miles/acres) of area affected per 5th field watershed. This estimation is set per 5th field watershed and Table 3 identifies the anticipated activities that could occur in each watershed based on:

- Opportunity for activity (e.g., access, funding)
- Need for activity (i.e., livestock fencing would only occur in watersheds with grazing allotments)

- Identified recovery actions

Not all 5th field watersheds have the same opportunities, for example, 11 of the 22 watersheds would have heavy equipment potentially operating in occupied habitat [See maps associated with proposed aquatic restoration actions in Appendix G of the Program BA (USDA SRNF 2015) for locations of potential heavy equipment sites].

Annual Project Limit: Project limits per 5th field watershed were set in order to prevent a cumulative impact of multiple projects generating sediment in one watershed or sub-watershed from occurring. The Level 1 Annual Coordination meeting would serve as another checkpoint for ensuring that annual project limits are appropriate and implemented accordingly.

In addition, in watersheds with TMDLs for sediment or turbidity the SRNF has a commitment to prevent cumulative impacts related to sediment from occurring because the Forest cannot exceed the waste allocation for the TMDLs.

Table 2. Upper Limits of WFR Program Activities

Restoration Activity	**Annual Project Limit in a single 5th Watershed**
Fish Passage Restoration *No anadromous fish passage projects on Forest Service roads* Fish passage projects would involve modification of legacy structures or modifying creek mouths for access to cool water refugia	1 w/Heavy Equipment 5 w/Hand Crews
Instream habitat enhancement Large Wood and Boulder placement	2 w/Heavy Equipment 5 w/Hand Crews
Gravel Augmentation	1 w/Heavy Equipment
Legacy/Historic Structure Modification or Removal 1 Penstock Dike located in Madden Creek that is proposed for removal.	2 w/Heavy Equipment 5 w/Hand Crews
Beaver Habitat Enhancement	2 – Reaches – no more than 1,000 feet. combination heavy equipment and hand crews
Off- and Side-Channel Habitat Restoration Potential reaches for these identified on the maps and primarily occur in the Klamath/Trinity. Other sites may be identified	2 combination heavy equipment and hand crews
Streambank Restoration	3 combination heavy equipment and hand crews
Reduction/Relocation of Recreation Impacts	2 w/Heavy Equipment 5 w/Hand Crews Each site typically less than ¼ acre
Livestock Fencing, Stream Crossings, and Off-Channel Livestock Watering	Less than 5 across Mad River and Lower Trinity Ranger Districts
Riparian Vegetation • Planting includes landslides • Alder Girdling - Individual locations would be small patches (0.5 acres) separated by untouched areas.	100 sites – all handcrews

Restoration Activity	**Annual Project Limit in a single 5th Watershed**
Non-native Invasive Plant Control A site would typically range from ¼ acre up to 2 acres with patchy ground disturbance	25 sites – all hand crews heavy equipment on existing access roads
Road and Trail Decommissioning	20 miles road decommissioning – validated by hydrologists annually based on TMDL compliance.
Road and Trail Maintenance and Upgraded (storm proofing) Mileage based on the historic amount of road maintenance completed on each District	60 miles per district of all activities See Appendix G-3 in the BA; activity descriptions for historic range of implementation for those that could produce sediment.
Illegal Marijuana Grow Clean up Ability to implement this activity is based on Law Enforcement approval of accessing sites.	5 sites per year
Mine Reclamation Most of the larger sites are addressed through the CERCLA process through EPA and would not be part of the WFR Program.	2 per year
In-channel Nutrient Enhancement Project locations would be identified in partnership with CDFW/NOAA	5 across the Forest
Fish Handling – By ESU/DPS: SONCC coho salmon NC steelhead CC Chinook salmon	By Population: 1 event per year Smith, Mid Klamath, Lower Trinity By Population: 1 event per year Mad, Van Duzen, NF Eel N/A – no occupied habitat on SRNF

Table 3. Anticipated activities that could occur in each 5th field watershed

5th Field Watersheds YO – Activity could occur within occupied habitat YOR – Activity could occur adjacent to occupied habitat - Riparian YA – Activity above[4] occupied habitat – instream/Riparian P – Potential- Surveys Required to Determine Need N/A - Activity unlikely to occur in watershed *(NMFS populations in parenthesis)*	SONCC Coho on FS land	NC Steelhead on FS land[3]	Fish Access to Habitat	Large wood and Boulder Projects – Heavy Equip.	Large wood Projects – Hand Treatment	Gravel Augmentation	Legacy/Historic Structure mod (incl. water diversion upgrades)	Beaver Habitat Restoration	Off-Side Channel Habitat Rest	Streambank Restoration	Reduction of Recreation Impacts	Livestock Fencing	Riparian Vegetation - planting	Riparian Vegetation - girdling	Non-native invasive plants	Road and Trail Erosion Control and maintenance	Road Decommissioning	Reduction of Impacts - IMG	Mine Reclamation	In channel Nutrient Enhancement	Lake and Pond Restoration
North Fork Smith (*Smith River*)	Yes	N/A	YO	YO	YO	N/A	N/A	N/A	P	YO	YO	N/A	YOR	YOR	YOR	YOR	YOR	P	YO	YO	N/A
Middle Fork Smith (*Smith River*)	Yes	N/A	YO	YO	YO	YO	YO	N/A	P	YO	YO	N/A	YOR	YOR	YOR	YOR	YOR	P	YO	YO	YA
South Fork Smith (*Smith River*)	Yes	N/A	YO	YO	N/A	YO	YO	N/A	P	YO	YO	N/A	YOR	YOR	YOR	YOR	YOR	P	YO	YO	YA
Lower Smith River (*Smith River*)	Yes	N/A	YO	YO	N/A	N/A	N/A	YO	N/A	YO	YO	N/A	YOR	YOR	YOR	YOR	YOR	P	N/A	N/A	N/A
Oak Flat-Ukonom (*Mid Klamath*)	Yes	N/A	YO	N/A	YO	N/A	N/A	P	N/A	YO	YO	N/A	YOR	YOR	YOR	YOR	YA	P	N/A	N/A	YA
Rock-Ti (*Mid Klamath*)	Yes	N/A	YO	YO	YO	P	YO	P	YO	YO	YO	N/A	YOR	YOR	YOR	YOR	YA	P	YO	YO	YA
Lower Mid Klamath (*Mid Klamath*)	Yes	N/A	YO	YO	YO	P	YO	YO	YO	YO	YO	N/A	YOR	YOR	YOR	YOR	YOR	P	YO	YO	YA
Dillon Creek (*Mid Klamath*)	Yes	N/A	YO	N/A	YO	N/A	N/A	P	N/A	YO	YO	N/A	YOR	YOR	YOR	YOR	YA	P	YA	N/A	YA
Blue Creek (*Lower Klamath*)	Yes[5]	N/A	P	N/A	P	N/A	N/A	N/A	N/A	YA	YA	N/A	YA	YA	YA	YA	N/A	P	N/A	N/A	YA
Wooley Creek (*Salmon River*)	Yes	N/A	YA	N/A	YA	N/A	N/A	N/A	N/A	YA	YA	N/A	YA	YA	YA	YA	N/A	P	N/A	N/A	YA
Main Salmon (*Salmon River*)	Yes	N/A	YO	YO	YO	P	N/A	P	YO	YO	YO	N/A	YOR	YOR	YOR	YOR	YA	P	YO	YO	YA
Main Trinity River (*Lower Trinity*)	Yes	N/A	YO	YO	YO	YO	YO	YO	YO	YO	YO	YA	YOR	YOR	YOR	YOR	YA	P	YO	YO	YA
Lower Trinity River (*Lower Trinity*)	Yes	N/A	YO	YO	YO	YO	YO	YO	YO	YO	YO	YA	YOR	YOR	YOR	YOR	YA	P	YO	YO	YA
Lower SF Trinity River (*SF Trinity*)	Yes	N/A	YO	YO	YO	YO	YO	YO	YO	YO	YO	YA	YOR	YOR	YOR	YOR	YA	P	YO	YO	YA
Redwood Creek (*Redwood Ck*)	No	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	YA	N/A	N/A	N/A	YA	N/A	P	N/A	N/A	N/A
Upper Mad River (*Mad River*)	No	No	N/A	YA	YA	N/A	N/A	N/A	N/A	YA	YA	YA	YA	N/A	YA	YA	YA	P	N/A	N/A	YA
Middle Mad River (*Mad River*)	No	Yes	N/A	N/A	YO	N/A	YO	N/A	N/A	YO	YO	YA	YOR	YOR	YOR	YA	YA	P	N/A	N/A	N/A
North Fork Eel River (*NF Eel River*)	No	Yes	P	N/A	YO	N/A	YO	N/A	N/A	YO	YO	YOR	YOR	P	P	YOR	YOR	P	N/A	N/A	YA
Bell Springs (*Mainstem Eel*)	No	No	N/A	N/A	P	N/A	N/A	N/A	N/A	P	N/A	YA	P	N/A	N/A	YA	P	P	N/A	N/A	N/A
Dobbyn Creek (*Mainstem Eel*)	No	Yes	N/A	N/A	P	N/A	N/A	N/A	N/A	P	N/A	YOR	P	N/A	N/A	YA	P	P	N/A	N/A	N/A
Upper Van Duzen (*Lower Eel/VD*)	No	Yes	P	YO	YO	N/A	N/A	P	P	YO	YO	P	YOR	P	P	P	P	P	N/A	N/A	N/A
Lower Van Duzen (*Lower Eel/VD*)	No	Yes	P	N/A	P	N/A	N/A	N/A	N/A	P	P	N/A	P	N/A	N/A	P	P	P	N/A	N/A	N/A

[3] Note that CC Chinook salmon not found on SRNF lands.
[4] Above – at a minimum, greater than 1500' upstream
[5] No known coho salmon presence on SRNF, however, CalFish distribution layer indicates potential occupancy on USFS administered lands.

Interrelated and Interdependent Actions

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

1.4 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The action area for the WFR Program covers those portions of California wherever SRNF administrative units (i.e., lands) are found. Table 4 lists the 5^{th} field watersheds that are included in the Program. Projects that occur on non-federal lands are included under this consultation when a project directly assists SRNF in achieving their aquatic restoration goals and the Forest Service contributes resources (funds, materials, planning, etc.) to the project. The Forest Service is permitted to fund such projects under Wyden Amendment authority (16 U.S.C. 1011(a), as amended by Section 136 of PL 105-277). To be included, non-federal land projects must follow all elements of the WFR Program. The SRNF will ensure that projects covered under this Program on non-federal land undergo the same review, design, implementation and post-project processes as projects occurring on SRNF administered lands.

Figure 1 identifies the general Action Area for some of the activities carried out under this program. The maps in Appendix A of the BA (USDA SRNF 2015) display the following location information:

- Instream/Riparian Activities – maps identify where past instream restoration activities have occurred and the locations of where activities are likely to occur under future NEPA decisions.
- Upslope Treatments – maps identify the National Forest Transportation System where road actions may occur. The maps also identify roads that have been decommissioned under previous NEPA decisions.

Appendix A-4 of the BA (USDA SRNF 2015) has a complete list of 5th field watersheds with key stresses and threats identified from the SONCC Coho Salmon Recovery Plan (NMFS 2015) and data from the Watershed Condition Framework to identify opportunities for restoration actions. Specific project locations and descriptions would be identified during the individual NEPA process by the SRNF.

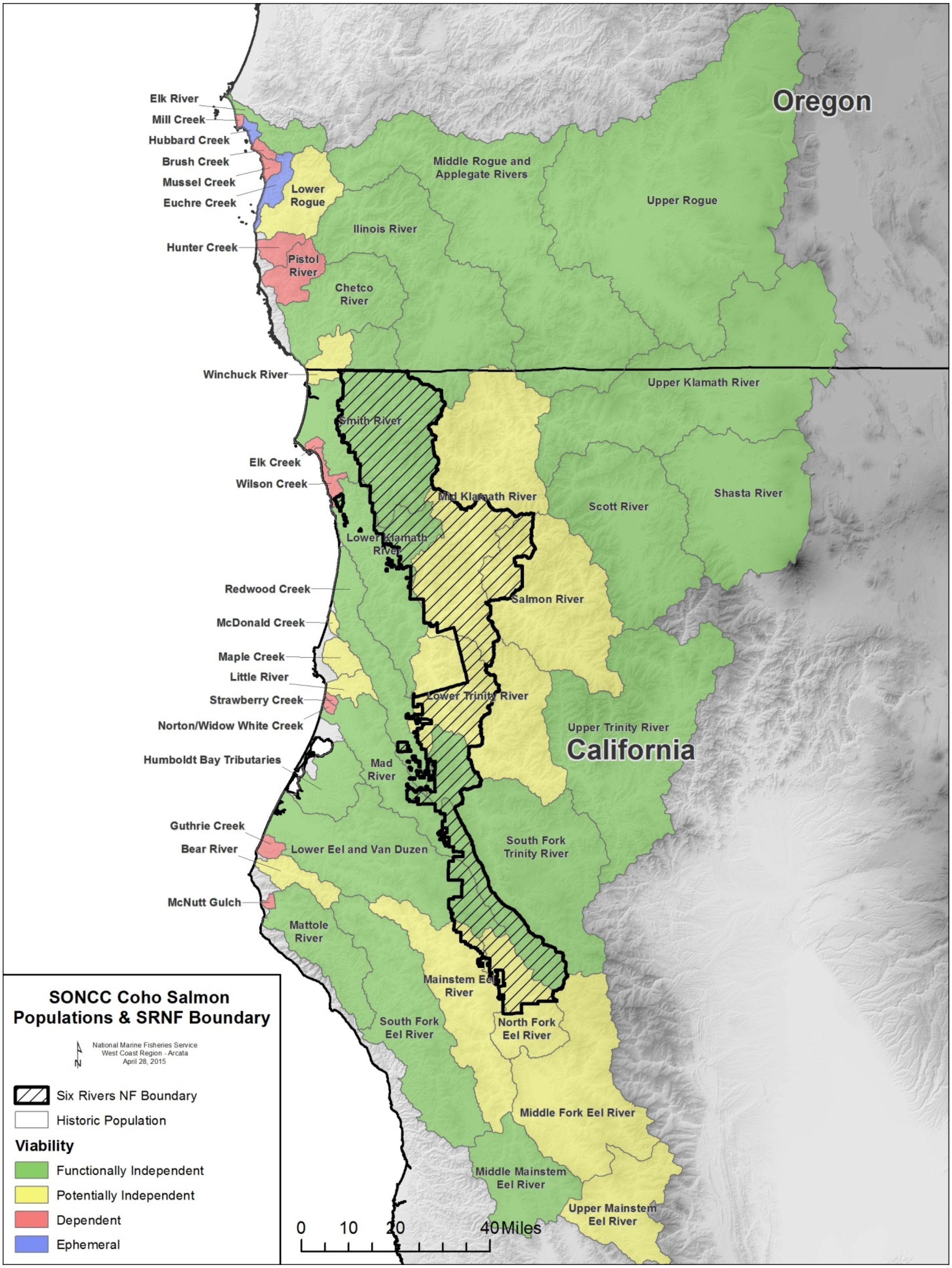

Figure 1. Map of WFR Program Action Area

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, Federal agencies must ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitat. If incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures and terms and conditions to minimize such impacts.

The proposed action is not likely to adversely affect California Coastal (CC) Chinook salmon (*Oncorhynchus tshawytscha*) or its critical habitat. The analysis is found in the "Not Likely to Adversely Affect" Determinations section (2.10).

2.1 Analytical Approach

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

The adverse modification analysis considers the impacts of the Federal action on the conservation value of designated critical habitat. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.[6]

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

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

---

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

- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat.
- Reach jeopardy and adverse modification conclusions.
- If necessary, define a reasonable and prudent alternative to the proposed action.

For this WFR Program consultation NMFS examined an extensive amount of information from a variety of sources, including the final SONCC Coho Salmon Recovery Plan (NMFS 2014), the Public Draft of the Multispecies Recovery Plan (NMFS 2015), and the Watershed and Fisheries Program Biological Assessment Biological Assessment (BA) (USDA SRNF 2015). The BA describes the environmental baseline using a variety of sources, including the NMFS recovery plans, the Matrix of Pathways and Indicators (NMFS 1996), the Watershed Condition Framework (USDA 2011a).

The Six Rivers National Forest is not able to precisely predict where specific WFR Program activities will be located or to describe site-specific conditions at future project sites. However, the effects of the covered WFR activities on listed species are analyzed programmatically considering the nature and scope of the various activities, habitat types and geographical areas, and ESA-listed species' needs and current stressors. Ultimately, all of the covered activities are expected to provide long-term benefits by improving existing habitat conditions for listed species that occur in the vicinity of WFR projects. The duration of the benefits will depend on the specific activity, and any other actions that occur in the future at a project site after WFR actions have been completed. The actual number of projects and acreages treated will depend on project opportunities, and the availability of funding and technical staff to develop and implement projects (USDA SRNF 2015).

Because the action area for this programmatic consultation is large, and exact project locations within the action area is not yet known, it is not possible to precisely define the current condition of fish or critical habitats in specific areas, the factors responsible for that condition, or the conservation role of those specific areas. Therefore, to complete the jeopardy and destruction or adverse modification of critical habitat analyses in this consultation, NMFS made the following assumptions regarding the environmental baseline in each area that will eventually be chosen for an action:

1. The purpose of the proposed action is to fund or carry out restoration actions designed to improve watershed conditions and enhance stream function for the benefit of ESA-listed species;
2. Specific project areas will either be occupied by listed coho salmon or steelhead, or will occur upstream of occupied habitat;
3. The biological requirements of individual fish in those areas (at the project site, or downstream) are not being fully met because aquatic habitat functions, including functions related to habitat factors limiting the recovery of the species in each area, are impaired; and
4. Active conservation enhancement at each site is likely to improve the factors limiting recovery of coho salmon and steelhead in that area.

Therefore, our analysis focuses not only on the expected effects of project implementation under the program, but also on the design and implementation of the program and program processes themselves.

2.2 Rangewide Status of the Species and Critical Habitat

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

Climate Change

One factor affecting the rangewide status of SONCC coho salmon, CC Chinook salmon and NC steelhead, and aquatic habitat at large, is climate change. Large reductions in available freshwater habitat due to climate change negatively impacts salmonids throughout the Pacific Northwest (Battin et al. 2007). Widespread declines in springtime snow water equivalent (SWE), the amount of water contained in the snowpack, have occurred in much of the North American West since the 1920s, especially since the mid-1900s (Knowles and Cayan 2004, Mote 2006). This decrease in SWE can be largely attributed to a general warming trend in the western United States (Mote et al. 2005, Regonda et al. 2005, Mote 2006), even though there have been modest upward trends in precipitation in the western United States since the early 1900s (Hamlet et al. 2005). The largest decreases in SWE are taking place at low to mid elevations (Mote 2006, Van Kirk and Naman 2008) because the warming trend overshadows the effects of increased precipitation (Hamlet et al. 2005, Mote et al. 2005, Mote 2006). These climactic changes have resulted in earlier onsets of springtime snowmelt and streamflow across western North America (Hamlet and Lettenmaier 1999, Regonda et al. 2005, Stewart et al. 2004), as well as lower flows in the summer (Hamlet and Lettenmaier 1999, Stewart et al. 2004).

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

Climate change has potential negative implications for the current and future status of ESA-listed fish in the Pacific Northwest. NOAA Fisheries reviewed recent studies on the potential effects of climate change in the Columbia River basin and the likely impacts on salmonids. The Independent Scientific Advisory Board (ISAB) described potential impacts of climate change that may result in alterations to the seasonal hydrograph, constrain habitat availability and accessibility, alter precipitation and temperature levels and, in particular, impact the various life-stages of salmon and steelhead (NMFS 2008). Long-term effects of this climatic variation on salmon and steelhead may include, but are not limited to, depletion of cold water habitat, variation in quality and quantity of tributary rearing habitat, alterations to specie migration patterns, accelerated embryo development, premature emergence of fry, and increased competition among species. Global effects of climate change on river systems and anadromous fish are often superimposed upon the local effects of logging, water utilization, harvesting, hatchery interactions, and development within river systems (Bradford and Irvine 2000, Mayer 2008, Van Kirk and Naman 2008).

SONCC Coho Salmon

NMFS listed SONCC coho salmon evolutionarily significant unit (ESU), which includes populations spawning from the Elk River (Oregon) in the north to the Mattole River (California) in the south, as a threatened species in 1997 (62 FR 24588; May 6, 1997). Reliable current time series of naturally produced adult migrants or spawners are limited for SONCC coho salmon ESU rivers (Williams et al. 2011, Good et al. 2005).

In 2005, NMFS reaffirmed its status as a threatened species and also listed three hatchery stocks as part of the ESU (70 FR 37160; June 28, 2005). In 2006, Williams et al. described the historical population structure of coho salmon in the SONCC coho salmon ESU based on the location and amount of potential coho salmon habitat, with an assumption that the relative abundance of different populations mirrored the amount of intrinsic habitat potential in each watershed. Williams et al. (2006) found that, in general, the SONCC coho salmon ESU was characterized by small-to-moderate-sized coastal basins in which habitat was concentrated in the lower portions of the basins (such as Redwood Creek), and by three large basins in which some habitat was located in the lower portions of the basins, relatively little habitat was available in the middle portions of the basins, and the greatest amount of habitat was located in the upper sub-basins (such as the Klamath River Basin). In 2008, Williams et al. then described the SONCC coho salmon historical population structure as containing19 functionally independent populations, 12 potentially independent populations, and 17 small dependent populations, and two ephemeral populations. Williams et al. (2008) also organized the independent and dependent populations of coho salmon in the SONCC ESU into diversity strata largely based on the geographical arrangement of these populations and basin-scale environmental and ecological characteristics.

Analysis of recent genetic data from coho salmon in this and adjacent ESUs (Oregon Coast ESU to the north and Central California Coast ESU to the south) supports the existing boundaries of the SONCC coho salmon ESU boundary (Stout et al. 2011, Williams et al. 2011). NMFS recently completed a status review of the SONCC coho salmon ESU (Williams et al. 2011) 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. 2011).

The following life history and status information is from this source and the 2014 SONCC coho salmon recovery plan:

Life History and Diversity

Life History

Typically, adult coho salmon reach sexual maturity at 3 years and die after spawning. Precocious 2 year olds, especially males, also make up a small percentage of the spawning population. Coho salmon adults migrate and spawn in small streams that flow directly into the ocean, or tributaries and headwater creeks of larger rivers (Sandercock 1991, Moyle 2002). Adults migrate upstream to spawning grounds from September through late December, peaking in October and November. Spawning occurs mainly in November and December, with fry emerging from the gravel in the spring, approximately 3 to 4 months after spawning. Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although they may move up to streams of 4 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.

Survival and distribution of juvenile coho salmon have been associated with available winter habitat (Bustard and Narver 1975, Peterson 1982, Tschaplinski and Hartman 1983, Nickelson et al. 1992, Quinn and Peterson 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, McMahon and Hartman 1989).

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 IP-km. 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 2014). The following table lists the SONCC coho salmon populations that overlap with Six Rivers National Forest.

Table 4. SONCC coho salmon populations in California on or immediately downstream of SRNF

Stratum	Population	Population Type	Risk of Extinction
Central Coast	Smith River	Core	High
	Lower Klamath River	Core	Moderate
	Redwood Creek	Core	High
	Mad River	Core	High
Interior Klamath River	Middle Klamath River	Non-core 1	High
	Salmon River	Non-core 1	High
Interior Trinity River	Lower Trinity River	Core	High
	South Fork Trinity River	Non-core 1	High
Southern Coastal	Lower Eel/Van Duzen River	Non-core 1	High
Interior Eel River	Mainstem Eel River	Core	High
	North Fork Eel River	Non-Core 2	High

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 (Williams et al. 2011) 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 by Williams et al. (2006), coho salmon status reviews (Good et al. 2005, Williams et al. 2011), 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 they are now absent (NMFS 2001a, Good et al. 2005,Williams et al. 2011). Scientists at the NMFS Southwest Fisheries Science Center compiled a presence-absence database for the SONCC coho salmon ESU (NMFS 2014) 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 streams.

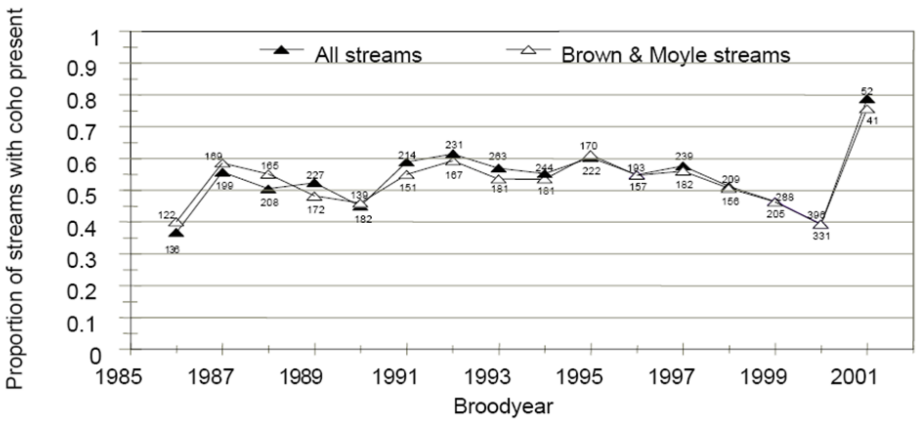

Figure 2. Number of streams with coho present (number of streams surveyed reported next to data point)

Using the NMFS database, Good et al. (2005) compiled information on the presence of coho salmon in streams throughout the SONCC ESU (Figure 2), which closely matched the results of Brown and Moyle (1991). 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, 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. 2005, 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. 2011). However, extant populations can still be found in all major river basins within the ESU (70 FR 37160; June 28, 2005).

Given that all diversity strata are occupied (Williams et al. 2011), 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.

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 (Morley et al. 2005, Swales and Levings 1989, Brown and Hartman 1988).

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. 2005) 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 are scarce, the available evidence from short-term research and monitoring efforts indicate that spawner abundance has declined since the last status review for populations in this ESU (Williams et al. 2011). In fact, most of the 30 independent populations in the ESU are at high risk of extinction because they are below or likely below their depensation threshold, 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. Coho salmon spawners in the Eel River watershed, which historically supported significant spawners (e.g., 50,000 to 100,000 per year; Yoshiyama and Moyle 2010), have declined. Yoshiyama and Moyle (2010) concluded that coho salmon populations in the Eel River basin appear to be headed for extirpation by 2025. One 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). Although long term spawner data are not available, both NMFS and CDFG believe the Lower Eel/Van Duzen River, Middle Mainstem Eel and Mainstem Eel River populations are likely below the depensation threshold, and thus are at a high risk of extinction.

Six Rivers National Forest Distribution/Abundance

Smith River: The lower 6 miles of the Smith River watershed has the high intrinsic potential for coho salmon. Distribution of coho salmon in the Smith River is extensive, however, forty percent of the watershed is known to be sloped over 50% gradient (Bartson 1997), and does not support coho salmon. Coho salmon occurrence in the Smith River National Recreation Area (NRA) has been low over the past 30 years, as indicated by annual spawning and juvenile fish surveys since 1976. Adult and juvenile coho are not observed in survey reaches on the NRA every year, but rather sporadically. Spawning and juvenile coho have been observed sporadically in the low gradient and gravel-rich reaches of large 6^{th} order tributaries of the North, South and Middle Forks Smith River, including Hurdygurdy, Patrick, and upper North Fork Smith (2007 Smith River Travel Management BA).

Klamath River: Coho occur in the mainstem Klamath River year round, and also inhabit a number of Klamath tributaries (Yurok Tribe 2001, CDFG 2002). Juvenile coho surveys have been conducted by the USFS, in cooperation with the CDF&G, USFWS and local Tribes, within the Klamath River mainstem and selected tributaries since 2002. Within the OTRRP, coho salmon populations are known to occur in Blue Creek, and between the Trinity and Salmon Rivers, in Camp Creek, Slate Creek, Bluff Creek, Aikens Creek, Red Cap Creek, and Boise Creek (L.Cyr, pers. comm. 2015). These annual surveys provide an indication of the low number of young coho salmon within many of these mid-Klamath tributaries within the action area. Many of the smaller tributaries provide a small (less than 0.2 miles) of habitat directly above the mainstem Klamath.

Trinity River: Information regarding coho distribution on SRNF in the Trinity River has been collected incidental to surveys for Chinook salmon. Several tributary streams to the mainstem Trinity River provide spawning habitat (Willow Cr., Horse Linto Cr., Cedar Ck. Sharber/ Peckham Cr.). Populations in the lower portion of Mill and Horse Linto creeks are extremely low.

Mad River: Limited data exists about the coho salmon population in the Mad River. Potential coho salmon habitat is primarily distributed in the downstream 40 percent of the basin. The area downstream of Matthews Dam, including Pilot Creek, is typically not accessible to coho salmon due to a series of boulder bedrock falls beginning at river mile 43.

Eel River (North Fork, Mainstem Tributaries): Differing opinions exist as to whether or not coho salmon were ever present in the North Fork Eel River above Split Rock. Low quality habitat exists if passage became possible. SRNF manages the headwaters of Dobbyn Creek and a very small portion of Kekawaka Creek. Coho salmon are currently present in the mainstem Eel River, however surveys have not found coho salmon to be present in either of these tributaries.

Van Duzen River: According to the SONCC coho recovery plan, coho salmon have been observed in the mainstem and tributaries of the lower Van Duzen River with the upper limit being identified at Grizzly Creek (NMFS 2014). SRNF lands are located over 20 miles upstream of this upper distribution.

NC Steelhead Trout

The NC steelhead DPS includes all naturally spawning populations of steelhead 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. Spence et al. (2008) identified 42 historically independent populations in the DPS based on habitat availability and gene flow among watersheds. An additional 33 small populations are likely dependent upon immigration from the more permanent populations (Bjorkstedt et al. 2005, NMFS 2011b).

Life History and Diversity

Life History

There are two basic steelhead life history patterns, winter-run and summer-run (Quinn 2005, Moyle 2002). Winter-run steelhead enter rivers and streams from December to March in a sexually mature state and spawn in tributaries of mainstem rivers, often ascending long distances (Moyle 2002). Summer steelhead, also known as spring-run steelhead, enter rivers in a sexually immature state during receding flows in the spring and migrate to headwater reaches of tributary streams where they hold in deep pools until spawning the following winter or spring (Moyle 2002). Spawning for all runs generally takes place in the late winter or early spring. Eggs hatch in 3 to 4 weeks and fry emerge from the gravel 2 to 3 weeks later (Moyle 2002). Juveniles spend 1 to 4 years in freshwater before migrating to estuaries and the ocean where they spend 1 to 3 years before returning to freshwater to spawn. 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 2002). Half pounders then return to the ocean where they spend 1 to 3 years before returning to freshwater to spawn. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death. 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 (Humboldt County and Stillwater Sciences 2011). 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 (Humboldt County and Stillwater Sciences 2011), but winter rearing juvenile steelhead become inactive and hide in any available cover, including large substrate or woody debris (Humboldt County and Stillwater Sciences 2011).

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. 2005), indicating that an important component of life history diversity in this DPS may be at risk. NMFS determined in the most recent status review 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. 2005), likely placing populations of NC steelhead at a higher risk of extinction (Williams et al.2011).

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. Table 5 lists the NC steelhead trout populations that overlap with Six Rivers National Forest. Of the NC steelhead populations that occur on or downstream of the SRNF, Redwood Creek, Mad River, Van Duzen River and North Fork Eel River are independent populations classified as essential for recovery (NMFS 2015), and Dobbyn Creek is a potential independent population classified as supporting recovery (NMFS 2015).

Table 5. NC steelhead populations in California on or immediately downstream of SRNF

Stratum	**Population**
Northern Coastal/Northern Mountain Interior	Redwood Creek
	Mad River
North Mountain Interior	Van Duzen River
	Dobbyn Creek
	North Fork Eel River

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 2011d) indicated that the biological status of the NC steelhead DPS has worsened since 2005.

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. 2005), 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. In response to observations of "large trout" above Eaton Falls (an assumed total passage barrier) on the Van Duzen, juvenile *o. mykiss* were sampled to determine if anadromous fish were spawning above this falls. Based on preliminary data, at least one juvenile located approximately 5 miles above the falls had markers indicating anadromous parentage (B. Harvey, USFS Research Fisheries Biologist, pers. comm. 2014)

As the 'default' historic spatial processes described by McElhany et al. (2000) have likely not been preserved, NMFS (Williams et al. 2011) 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. 2011).

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.

Abundance

Steelhead abundance has been monitored at three 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, California Department of Fish and Game (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. (2005) 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. 2005). The most recent status reviews (Williams et al. 2011) 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. 2011). 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. 2011). 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 ($p>0.05$).

Only the Middle Fork Eel River summer-run steelhead populations approached low-risk thresholds established by the Technical Review Team (TRT) (Williams et al. 2011). 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. 2011).

Busby et al. (1996) and Good et al. (2005) concluded that the NC steelhead DPS was not in danger of extinction, but was likely to become endangered in the foreseeable future. In the most recent status review update, Williams et al. (2011) found that historical and current information indicates that NC steelhead populations are depressed in basins where they are being monitored. Williams et al. (2011) concluded, albeit with limited data, that: (1) population abundances are low, compared to historical estimates; (2) recent trends are downward, although not significantly, (3) summer-run steelhead abundance remains low, (4) in the Mad River, the high number of hatchery fish in the basin, coupled with the uncertainty about the relative abundance of hatchery and wild spawners is of concern, and (5) the status of NC steelhead was unchanged from that determined by Good et al. (2005).

Six Rivers National Forest Distribution/Abundance

Mad River: Steelhead are distributed up to Matthews Dam, although uncertainty exists as to how many steelhead surpass the boulder/bedrock falls (Bug Creek falls). Tributary use for spawning is probable; however, most tributaries dry up leaving only pockets of water for rearing. Pilot Creek is the largest tributary upstream of these falls. Basin wide summer steelhead surveys were performed in 2013 and 2014 by Mad River Alliance. One summer steelhead was found on USFS lands in the reaches below Matthews Dam during both surveys (K. Kenfield USFS, pers. comm. 2014). Summer steelhead have been observed in Pilot Creek and the upper Mad River below Mathews Dam during previous summer steelhead surveys (Stillwater Sciences 2010).

Eel River (North Fork, Mainstem Tributaries): Steelhead are present in the North Fork Eel River above Split Rock, although summer steelhead are believed to be extirpated (Moyle 2002). Resident rainbow trout are found co-located with anadromous steelhead. Juvenile young-of-year steelhead and resident rainbow trout are found in intermittent pools in the summer months. Many tributaries dry up leaving isolated pools. The North Fork Eel River is not part of designated critical habitat for NC steelhead. SRNF also has lands in the headwaters of Dobbyn Creek and lands in a very small portion of Kekawaka Creek. Steelhead are present in the mainstem Eel River, with NC steelhead critical habitat reaching up on to SRNF lands in Dobbyn Creek.

Van Duzen River: Steelhead were believed to be unable to surpass Eaton Roughs to reach SRNF lands. The 2014 genetic sampling discussed previously in this *Status* section shows that steelhead may be able to migrate upstream of Eaton Roughs, however it is likely to occur in extremely rare circumstances given the conditions at Eaton Roughs. Steelhead do migrate up the Little Van Duzen River to Forest Service lands, but the numbers spawning are unknown.

Critical Habitat

Critical habitat is defined as: (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation.

NMFS designates critical habitat by determining the conservation value of particular areas and balancing the benefits of designation against its impacts (e.g., economic, national security). The proposed designation then goes through a period of public comment before the final rule is published and critical habitat is designated.

Information and GIS layers for SONCC coho salmon, NC steelhead and CC Chinook salmon is located at the following NMFS website:

http://www.westcoast.fisheries.noaa.gov/habitat/critical_habitat/critical_habitat_on_the_wc.html

SONCC Coho Salmon Critical Habitat

Description

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 (May 5, 1999, 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% private lands; 36% Federal lands; 10% State and local lands; and 1% 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; May 5, 1999).

Current Condition

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).

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.

Mapping

Since the Federal Register did not provide a map of coho salmon critical habitat, SRNF conclusions regarding critical habitat occurrence are based on field review of habitat suitability as defined by the Intrinsic Potential model[7] (NMFS 2006), professional judgment, SRNF fish survey records, and California Department of Fish and Wildlife (CDFW) survey information. Where information on coho salmon critical habitat is lacking (e.g., no/few surveys have been completed), or if SRNF or Calfish.org range maps do not fully capture CH extent, the SRNF steelhead distribution (GIS) layer may be used as a proxy for maximum range of anadromous fishes, including coho salmon. This steelhead distribution map is recognized as a conservative approach for assessment of effects to anadromous fish habitat because coho and Chinook salmon distribution does not occur as far upstream as steelhead distribution due to differences in jumping abilities. The maximum jumping height (under ideal conditions) for coho salmon is 2.2 meters; Chinook salmon is 2.4 meters; and steelhead is 3.4 meters (Meehan 1991). Therefore, steelhead can access more upstream habitat than coho or Chinook salmon (i.e., steelhead can make a 3-meter jump to migrate up a stream, but coho and Chinook salmon cannot.). Additionally, differences in spawn timing may also affect actual distribution. In all cases field review and site-specific surveys may refine the location of coho salmon critical habitat.

NC Steelhead Critical Habitat

Description

NMFS designated critical habitat for seven of the ESUs/DPSs of Pacific salmon and steelhead, including NC steelhead in September 2005 (70 FR 52488, September 2, 2005). Specific PCEs, 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 PCEs, 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, September 2, 2005).

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 (NMFS 2005). 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.

Current Condition

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

---

[7] Since information concerning the historical distribution of SONCC coho was lacking through a large portion of the their ranges and biological data necessary to assess carrying capacity directly was also lacking, the technical recovery teams made use of habitat-based proxies for historical use and environmental capacity as a measure of a population's carrying capacity. To develop such proxies, they implemented a GIS model that predicts the distribution of species-specific "intrinsic potential" (IP) for habitat suitable for spawning or juvenile rearing (Williams et al. 2006)

concentrated. Levees constrain most estuaries and lower rivers in this DPS and prevents 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.

2.3 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

Setting

As previously described, the action area includes Six Rivers National Forest lands that overlap the following SONCC coho salmon watersheds/populations: Smith River, Redwood Creek, Mad River, North Fork Eel River, Mainstem Eel River, Lower Eel River/Van Duzen River, Middle Klamath River, Lower Klamath River, Salmon River, Lower Trinity River, and South Fork Trinity River.

The action area has a Mediterranean climate characterized by cool, wet winters with typically high runoff; and dry, warm summers characterized by greatly reduced instream flows. While fog is a dominant climatic feature along the coast, the higher elevations and inland areas where SRNF lands are found tend to be relatively fog free. Most precipitation falls during the winter and early spring as rain, with occasional snow above 1,600 feet. The action area receives one of the highest annual amounts of rainfall in California, with a few sections averaging over 85 inches a year. Mean rainfall amounts range from 9 to 125 inches. Extreme rain events do occur, with over 240 inches recorded over parts of the action area during 1982/83. Along the coast, average air temperatures range from 46 °F to 56 °F. Farther inland and in the southern part of the action area, annual air temperatures are much more varied, ranging from below freezing in winter to over 100 °F during the summer months.

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

Native vegetation in the action area includes Douglas-fir (*Pseudotsuga menziesii*) intermixed with hardwoods, to ponderosa pine (*Pinus ponderosa*) and Jeffery pine (*Pinus jefferyi*) stands along the upper elevations. Grasslands are located along the main ridge tops and south-facing slopes of the watersheds.

Urban development is found primarily on the estuaries of the larger streams many miles downstream of SRNF lands. Small towns and rural residences are located throughout the action area. Forestry is the dominant land-use throughout the action area, although there is some agriculture.

Background

Though relatively productive, streams on the SRNF are still impaired by the legacy effects of floods, fire and land use. In 1964, a major flood changed the riparian areas with the removal of large stream side conifers. Concerned over fish passage and landslide aggravation, biologists at the time removed resulting log jams. On the mainstem Klamath and Trinity Rivers, the dams, development and highways have altered most of the mainstem channel, changed the rise and fall of the river and disconnected side-channel habitat from the river. Historically, these side-channels were part of a web of small tributaries, wet meadows, oxbows, beaver ponds and these off-channel habitats along the river provided important summer rearing and winter refuge for resident and anadromous fish.

Stream surveys in the 1970s indicated streams responded to the 1964 flood with simplified instream habitat and riparian areas dominated by young alders. In the 1980 and early 1990s, Six Rivers National Forest, partnering with California Department of Fish and Wildlife [Game] and the other river restoration programs, focused on increasing the complexity of instream habitat through various grants programs. Mid 1990s and the publication of FEMAT encouraged managers to look to the hillsides to restore natural processes of sediment and vegetation. Since the signing of the Six Rivers National Forest Land and Resource Management Plan (LRMP) in 1995 (which incorporated the Northwest Forest Plan in its entirety), the SRNF has decommissioned roads, planted landslides and upgraded necessary road systems to both reduce known sediment sources and the risk of future impacts [see Appendix A in the BA (USDA SRNF 2015) for maps showing history of restoration].

NMFS released the final SONCC Coho Salmon Recovery Plan in September 2014, and the Public Draft Multispecies Recovery Plan in September 2015. The recovery plans were developed to provide a roadmap to recovery which conservation partners, such as the SRNF, can follow together. Specifically, the recovery plans were designed to guide implementation of prioritized actions needed to conserve and recover threatened salmonid species by providing an informed, strategic, and voluntary approach to recovery that is based on the best available science. Actions carried out under the WFR Program implement portions of the recovery plans as described in the Proposed Action section of this BO. The recovery plans also identify threats and stresses that are not addressed in the WFR Program. For example, actions to reduce the risk of high severity fires, while important for long term recovery of listed salmonids, are not addressed in the WFR Program.

Watersheds and Populations within the Action Area

Smith River

The final NMFS Recovery Plan for Coho Salmon (NMFS 2014) describes that the Smith River population of coho salmon is currently at high extinction risk due to low abundance and productivity. The Smith River coho salmon population may be below the depensation level of 325 spawners, and is much below the 6,800 spawners needed for ESU viability. NMFS (2014) also describes in its recovery plan that the key limiting stresses are impaired estuary and mainstem river function and lack of floodplain and channel structure.

The distribution of coho salmon in the Smith River is extensive. However, forty percent of the watershed is known to be sloped at over 50 percent gradient (Bartson 1997), and does not support coho salmon. Coho salmon extend throughout the majority of lower tributaries and also use the middle and upper tributaries, but the extent of use is unknown because of the species' preference for inclines less than 3 percent (Bjornn and Reiser 1991, Garwood 2012). Middle and upper reaches have a significant amount of suitable habitat and can support coho salmon rearing. Studies conducted in the Smith River from 1979 to 2002 show that nearly all of the tributaries in the lower river were occupied by coho salmon (Garwood 2012). The South Fork Smith River has a low gradient, is fully accessible, and is used by spawning coho salmon. Coho salmon have also been observed in a number of tributaries in the North Fork Smith River. The Smith River watershed is in 78 percent federal ownership, most of this managed by the SRNF.

Current estimates of the abundance and distribution of the Smith River coho salmon population are based on studies that have been conducted over the past several decades (NMFS 2014). These include a long-term data set describing salmon abundance in the West Branch and East Fork Mill Creek (McLeod and Howard 2010) since 1994. Within West Branch of Mill Creek, adult coho salmon spawner counts have ranged from a high of 175 to a low of 3 between 1994 and 2009 with decreases in numbers seen in more recent years (McLeod and Howard 2010).

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

A legacy of mining roads and open pits and shafts that were used and operated in the 1850s to 1950s still exist in the North Fork Smith River sub-basin and in the Hardscrabble, Myrtle, Patrick, and Shelly sub-watersheds. Many of these mining features are chronic sources of sediment since revegetation, and restoration is difficult due to the inherent harsh soil conditions of these areas. Hydraulic mining was intensive in low-gradient reaches of several tributaries, significantly altering stream channel characteristics and impacting fish habitat (USDA SRNF 2015).

A widespread and aging road network continues to present a sediment hazard to channels and aquatic habitat in the Smith River basin. The SRNF has released a draft environmental impact statement analyzing a range of alternatives for developing a road and trail network that reduces the impacts from roads by upgrading or decommissioning (USDA 2014). Appendix A-3 in the BA (USDA SRNF 2015) provides more specific information (e.g., potential sediment sources, road density and location, drainage network increases, and effects from road drainage features) on watershed and road conditions in the Smith River National Recreation Area (i.e., SRNF lands).

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

Klamath and Trinity Rivers

The portions of the Klamath and Trinity River basins managed by the SRNF contain the Middle Klamath, Salmon River, Lower Trinity and South Fork Trinity populations of SONCC coho salmon. The Klamath River once supported diverse, abundant anadromous fish runs thought to number in the millions. Now, all of the anadromous fish species inhabiting the Klamath River are in a state of decline (NMFS 2014), especially those species or stocks that depend on summer freshwater aquatic habitat, such as coho salmon.

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

Lower summer flows emanating from the Klamath Project (*i.e.*, released at Iron Gate Dam) are exacerbated by diminished inflow from many of the major tributaries to the middle Klamath River. The Klamath and Trinity rivers both contain numerous instream barriers upstream of SRNF lands that preclude salmon and steelhead migration into much of their historic range.

Much of the middle reach of the Klamath River basin (*i.e.*, between the confluence of the Trinity River and Iron Gate Dam) and Trinity River basin is under Federal ownership and not managed for intensive timber harvest. Both the Klamath River (nutrients, organic enrichment/low dissolved oxygen, and temperature) and Trinity River (sedimentation/siltation) are listed under section 303(d) of the CWA as water quality limited (CSWRCB 2003).

Middle Klamath River

In the Recovery Plan for SONCC coho salmon, NMFS (2014) characterizes the Middle Klamath River population as at moderate extinction risk. Williams et al. (2008) determined at least 113 coho salmon must spawn in the Middle Klamath each year to avoid the effects of extremely low population sizes. Based on the available data, the Middle Klamath River coho salmon population likely has an average spawner abundance of 200-600 individuals, and is at moderate risk of extinction given the low population size and negative population growth rate (Ackerman et al. 2006). Based on current estimates, the population is likely above depensation, but well below the low-risk threshold of 3,900 spawners.

Juvenile counts indicate that productivity is relatively low, with less than 12,000 juvenile coho salmon found between 2002 and 2009 during surveys of Middle Klamath tributaries (USFS 2009a). Most of the observations are of juveniles using the lower parts of the tributaries and it is likely that many of these fish are non-natal rearing in these refugia areas. Natal rearing is likely confined to those tributaries where spawning is occurring and where sufficient rearing habitat exists (Boise, Aikens, Bluff, Slate, Thompson, Red Cap, Elk, Indian, Independence, Titus, Seiad, Horse, China, Beaver, Clear, and Camp creeks).

Adults and juveniles appear to be well distributed throughout the Middle Klamath; however, use of some spawning and rearing areas is restricted by water quality, flow, access, and sediment issues. The key limiting stresses for this population are impaired water quality and lack of floodplain and channel structure, as they have the greatest impact on the population's ability to produce sufficient spawners to support recovery. There are also other stresses that limit the function of habitat for certain life stages in the Middle Klamath and therefore limit productivity of this population. The lack of quality summer and winter rearing habitat that is protected from warm temperatures and high winter flows, respectively, is one of the most likely factors limiting productivity (Soto et al. 2008). Summer rearing occurs in cold-water tributaries and other thermal refugia along the mainstem. This type of rearing habitat is limited in terms of its quality, quantity and connectivity within the Middle Klamath River. In the summer, water diversion leads to poor hydrologic function, disconnection and diminishment of thermal refugia, and poor water quality. Accretion of sediment at creek mouths also limits access to important thermal refugia and summer rearing habitat. Winter rearing occurs primarily in mainstem, confluence, and tributary habitats where backwaters, alcoves, off-channel ponds and wetlands have formed. Winter rearing habitat has been primarily impacted by past mining activities and construction of flood control levees in the mainstem and in many tributaries, which has led to the loss and degradation of floodplain and channel structure. The majority of winter habitat that does exist is small, has poor quality, and is poorly connected. In addition to juvenile rearing habitat, mainstem disease issues may be limiting the productivity of the population during certain years. Note that 98 percent of this watershed area is in federal ownership.

Salmon River

As described by NMFS (2014) in the Recovery Plan for SONCC coho salmon, survey data indicates that there are low numbers of coho salmon, and that the population is below depensation levels, and at high risk of extinction. In most years, only a handful of adults and/or redds are found during the spawning season. Annual returns of adults are likely less than 50 per year (SRRC 2008b). Since stream flow level and visibility in the Salmon River watershed often make coho salmon surveys difficult or impossible, these estimates could be the result of the inability to count all individuals present as well as the low abundance of the population.

Twelve percent of the 1,414 miles of stream within the Salmon River watershed are able to support anadromous salmonids, due to the mountainous topography and associated hydrology of the landscape (Elder et al. 2002). Coho salmon habitat includes the mainstem Salmon River, Wooley Creek, the North Fork and South Fork Salmon Rivers, and the lower reaches of a few smaller tributaries. For this reason, coho salmon in the Salmon River population are naturally restricted in their distribution. Ninety-nine percent of this watershed is in federal ownership.

Juvenile coho salmon have been found rearing in most of the available tributary habitat with suitable habitat. These streams are tributaries to the South Fork Salmon (Knownothing and Methodist Creek), at least nine tributaries to the North Fork Salmon, and in mainstem Salmon River tributaries of Nordheimer and Butler Creeks (SRRC 2008a). The lower reaches of these tributaries provide substantially cooler summer habitat than mainstem river habitat. Current data only includes presence/absence information; however, there is some indication that juvenile coho salmon move up from the mainstem Klamath River into the cooler Salmon River tributaries during summer months when stressed by mainstem water temperatures (USFS 2009b). Juveniles found in surveys are thought to be of both natal and non-natal origin.

Lack of floodplain and channel structure and degraded riparian forest conditions are the key limiting stresses for the Salmon River population of coho salmon. Water quality and riparian conditions are both degraded in the watershed and off-channel habitat is minimal due to the bedrock geology and steep terrain. The Salmon River Restoration Council analyzed what limiting factors were important for Spring Chinook salmon in the watershed and found that temperature (in the mainstem Klamath and Salmon River), pool size and quantity, thermal barriers, flow, disease, and sediment embeddedness were all important factors limiting productivity of that population, and likely the Salmon River coho salmon population as well (SRRC 2008b).

South Fork Trinity River

The only population estimates for the South Fork Trinity River are based on work by Jong and Mills (1992) who estimated that 127 adult and jack coho salmon returned to the South Fork Trinity River in 1985 and 99 returned in 1990. In 1985, several hundred coho salmon juveniles were trapped in the South Fork Trinity River below the mouth of Madden Creek (CDFG 1993). More recent data on population sizes, other than that of Jong and Mills (1992) are unavailable. Williams et al. (2008) determined at least 242 spawners are needed each year in the South Fork Trinity River to avoid depensatory effects of extremely low population sizes. If we assume abundances are similar to those found in 1985 and 1990, the South Fork Trinity River population does not meet this depensation threshold and is at high risk of extinction (NMFS 2014). The population growth rate in South Fork Trinity River basin has not been quantified but is likely negative based on loss of habitat, declining water quality, and detrimental hatchery influences.

Coho salmon are limited in their distribution in the South Fork Trinity River basin and occur only in the mainstem South Fork Trinity River up to Butter Creek, Butter Creek, Hayfork Creek up to Corral Creek, Eltapom Creek, Olsen Creek, and Madden Creek (Everest 2008; Boberg 2008). There are no know barriers to migration for coho salmon in the South Fork

Trinity River upstream of Butter Creek, and Rattlesnake Creek has suitable habitat. Yet no coho salmon are known to inhabit these stream reaches. Coho salmon have not been found in Hayfork Creek near or upstream of the town of Hayfork. This area has the greatest concentration of high value habitat of any stream in the basin. It is not clear if coho salmon are currently able to migrate through Hayfork Creek upstream of Corral Creek, or if they were historically able to migrate past Corral Creek. However, it is likely that habitat conditions, such as high summer water temperatures and low dissolved oxygen, arising from land use, water utilization, climate change and channel aggradation are currently limiting the spatial structure of coho salmon in the South Fork Trinity River basin.

Several factors limit the viability of the South Fork Trinity River coho salmon population. The most dominant of these factors stem from the effects of agricultural practices on private land, legacy sediment-related impacts from past floods, fire, and land management. Impaired water quality and altered hydrologic function are the most likely stresses limiting productivity of the South Fork Trinity population (NMFS 2014). Eighty-two percent of this watershed is in federal ownership.

Lower Trinity River

The limited data available from the USFS and the Hoopa Valley Tribe for the Lower Trinity River population suggests that much of the suitable habitat in the Lower Trinity River is currently unoccupied or only sporadically occupied (NMFS 2014). Brood year cohorts may be missing and the adult coho salmon population is likely less than the depensation threshold of 112 adults, thus the high extinction rating for this population in the Recovery Plan for SONCC coho salmon (NMFS 2014). Williams et al. (2008) determined that the low risk spawner abundance threshold for this population is 3,900.

Good spawning habitat exists in a few tributaries in the Lower Trinity area. The Burnt Ranch and New River areas have some of the best known spawning habitat in the population area. Tributaries known to support coho salmon spawning and/or rearing include Mill Creek, Horse Linto Creek, Tish Tang Creek, and Sharber-Peckham Creek. Sharber- Peckham Creek likely supports the highest number of spawning coho salmon (USFS 2001; Boberg 2008). The SRNF indicated that populations in the lower portions of Mill and Horse Linto creeks are extremely low, particularly in Horse Linto Creek since 1995 (USFS 2001). The USFS (2000) reported that coho salmon are rarely found in the New River although this is one of the largest watersheds with the potential for coho salmon production based on the availability of suitable habitat in the sub-basin. Based on this current distribution of coho salmon in the Lower Trinity, most of the historic habitat of the Lower Trinity River remains accessible to coho salmon, though many of the streams are unoccupied, or sporadically occupied.

Several factors limit the viability of the Lower Trinity population. The most dominant of these factors stem from negative impacts of the altered hydrologic function and altered floodplain and channel structure. The juvenile life stage is the most limited and quality summer and winter rearing habitat is lacking for the population. Overall, the capacity of the Lower Trinity to support juveniles and other life stages of coho salmon has been reduced by these impacts (NMFS 2014).

As described in the Recovery Plan for coho salmon (NMFS 2014) the lack of floodplain and channel structure impacts have a major impact on the productivity of this population. Rearing opportunities and capacity are low due to disconnection of the floodplain, a lack of LWD inputs, poor riparian conditions, and sediment accretion. Low-lying areas of streams such as Supply, Mill, and Willow Creek have been channelized, diked, and disconnected from the floodplain. There exists very little off-channel habitat that can be used for rearing and refugia. The mainstem river also lacks side channel, backwater, and wetland habitat for winter refugia habitat. Lack of complex habitat also impacts summer rearing conditions.

Given the number of diversions and the potential amount of water withdrawn from the mainstem Trinity River and its tributaries, a lack of hydrologic function could also be potentially limiting coho salmon production in the Lower Trinity population. Many tributaries likely experience unnatural seasonal low flow conditions that prohibit their use during the summer. Thermal refugia on the mainstem may also be impacted by reduced flows through a reduction in the extent, duration, or quality of refugia areas. Given the importance of tributary rearing habitat and thermal refugia on the mainstem a loss of hydrologic function could have a major impact on juvenile coho (NMFS 2014). Ninety-one percent of this population area is in federal ownership.

Redwood Creek

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

Logging, road building, and the construction and maintenance of flood control levees are the land uses that have had the most pronounced effect on coho salmon habitat in the Redwood Creek basin. The lower portion of the watershed was historically logged prior to the creation of the Redwood National Park. Much of the upper and middle portions of the basin are owned by private timber companies and are used for timber production. In addition, livestock grazing occurs on some private lands, both in the middle and upper portions of the basin and in the valley bottom near Orick, where the grazing land is protected by flood control levees. Six Rivers National Forest manages approximately 1% of the headwaters of Redwood Creek, upstream of coho salmon and steelhead distribution.

Mad River

The Mad River watershed has endured a long legacy of watershed disturbance. Streamside vegetation removal, channel modifications, and instream gravel extraction dating back many decades, combined with intensive upslope activities such as timber harvest and road construction, have had a significant influence on the condition of the watershed. Furthermore, the Mad River watershed is section 303(d) listed for turbidity and sedimentation due to timber harvest, resource extraction, and nonpoint sources (CSWRCB 2003). A principal contributor of fine sediment is hydrologically connected road segments. As described in the final NMFS Recovery Plan for SONCC Coho Salmon (NMFS 2014), key limiting stresses for the Mad River population include altered sediment supply and lack of floodplain and channel structure. Coho salmon are currently thought to be at high risk of extinction in this watershed as the population abundance is likely less than the threshold of 540 spawners needed for recovery and ESU viability (NMFS 2014).

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

Potential coho salmon habitat is primarily distributed in the downstream 40 percent of the basin, downstream of SRNF lands. The area downstream of Matthews Dam (i.e., SRNF) is typically not accessible to coho salmon due to a series of boulder and bedrock falls (known as “the roughs”) that begin at Blue Slide Creek, RM 43, and extend to Deer Creek at RM 53 (Stillwater Sciences 2010). Since 1961, access to the upper basin (i.e., SRNF lands) has been blocked at Matthews Dam.

Available information from the Public Draft of the Multispecies Recovery Plan (NMFS 2015) indicates that the population of adult winter-run steelhead in the Mad River is greater than the high risk threshold identified by Spence et al. (2008) of 352 adult spawners, but substantially less than the low risk threshold of 7,000. Spence et al. (2008) wrote that they did not have enough data available on Mad River winter-run NC steelhead to determine the current population viability.

Summer-run steelhead snorkel surveys for the period 1994-2005 indicate a high of 617 and a low of 80 adults CDFG (2007) in the Mad River. From 1994 to 2002, the geometric mean abundance was about 250 with a decreasing trend (Spence et al. 2008). Spence et al. (2008) concluded that the snorkel survey data on Mad River summer-run NC steelhead was enough evidence to categorize this population of having at least a moderate risk of extinction.

Steelhead have been documented in all fish bearing tributaries of the Mad River watershed, up to tributary migration barriers (Stillwater Sciences 2010). The boulder roughs near Deer Creek (RM 53), restricts mainstem passage during low to moderate flows. However, adult steelhead are found in Pilot Creek (RM 58; Stillwater Sciences 2010) and as far upstream as Mathews Dam, both in the middle to upper watershed on SRNF lands.

Population growth rates for salmonids in the Mad River have not been quantified. The closest researchers have come to this goal is when Spence et al. (2008) described diver surveys which demonstrated the number of adult summer-run steelhead in three reaches of the Mad River declined at an average rate of 23 percent per year over two generations (from 1994 to 2002). The apparent decrease in population sizes of Mad River coho salmon, Chinook salmon, and steelhead indicates the populations are not replacing themselves.

The steelhead population in the Mad River watershed is also at risk from adverse hatchery effects. NMFS (2014) specifically identified the past practices of the Mad River Hatchery as potentially damaging to NC steelhead. CDFG out-planted non-indigenous Mad River Hatchery brood stock to other streams within the DPS, and attempted to cultivate a run of non-indigenous summer-run steelhead within the Mad River. CDFG ended these practices in 1996. The current operation of the Mad River Hatchery has been identified as having potentially harmful effects to wild salmon populations as well.

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

Increased sediment delivery has aggraded and widened channels, filled pools, and simplified stream habitat throughout the basin. Data from the SRNF suggest that sediment supply may be less of an issue in the upper basin. Data collected on the sediment budget during TMDL development (USEPA 2007) indicate that both stored sediment within the channels and continued sediment delivery are critical stresses affecting the population. The USEPA (2007) found that the middle Mad River area produces the greatest sediment relative to other areas of the basin, due to active landslides and active land management (e.g., timber harvest).

Eel River – North Fork Eel and Van Duzen Rivers

Historic land and water management, specifically large-scale timber extraction and water diversion projects, contributed to a loss of habitat diversity within the mainstem Eel River and many of its tributaries. The Eel River is listed under section 303(d) of the CWA as water quality limited due to excessive sediment and high water temperatures (CSWRCB 2003). Essential habitat feature limitations include high water temperatures, low instream cover levels, high sediment levels, and low LW abundance.

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

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

North Fork Eel River

The North Fork Eel River watershed is a very rugged and remote watershed characterized by gentle upland terrain that has been dissected by steep, inner gorge canyons. The bulk of sediment generated by landslides is of natural, non-management related origin. The mainstem North Fork Eel River is primarily low-gradient interspersed with higher-gradient boulder and bedrock stretches. The channel is defined by large amounts of course sediment (e.g. gravel, cobble, boulder) especially in the mainstem and major tributaries.

Little historical information is available for instream habitat conditions in the drainages of the North Fork Eel river watershed. The earliest surveys were done in the 1970s and were simple qualitative surveys with no flow data or other physical parameters collected. For the North Fork Eel River and its tributaries, Tom Keter, SRNF archaeologist, (Keter 1995), states that long-time residents of the area interviewed agreed that 40 to 60 years ago the streams within that basin used to run at higher water levels in the summer than they do today. If true, it may be sufficient reason there were a greater number and diversity of anadromous fish (summer steelhead and Chinook salmon were historically present). Water quality within the North Fork Eel River is listed as sediment and temperature impaired under Section 303(d) of the Clean Water Act and was assessed through the Total Maximum Daily Load process (TMDL).

The NMFS recovery plan for coho salmon (NMFS 2014) describes potential habitat for coho production throughout the watershed, indicating the North Fork Eel could have once been used by coho salmon. However, a boulder-built barrier is located approximately 3.5 miles upstream of the confluence with the mainstem Eel River. Currently, coho salmon are not found on SRNF lands, and are located many miles downstream (NMFS 2014). As described in the Public Draft of the Multispecies Recovery Plan (NMFS 2015), Split Rock likely also acts as a partial migration barrier to steelhead during certain flows, and little is known of current steelhead abundance in the watershed, although steelhead are document to occur on SRNF lands (USDA SRNF 2015).

Van Duzen River

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

As described in the Public Draft of the Multispecies Recovery Plan (NMFS 2015), there are two natural barriers on the mainstem of the Van Duzen River that limit passage of steelhead (CDFG 2012a). Salmon Falls, (RM 36.7) near the confluence of Bloody Run Creek, and Eaton Roughs (RM 46). Adult steelhead are able to pass Salmon Falls under most conditions but are generally unable to pass Eaton Roughs in most years. A recent genetics study indicates steelhead occasionally reach the upper watershed [as cited as a personal communication with Bret Harvey in the BA (USDA SRNF 2015)]. Coho salmon do not occur in the mid to upper Van Duzen

River, as their migration is blocked at Salmon Falls (RM 36.7), many miles downstream of SRNF lands (NMFS 2014).

There are limited, inconclusive data documenting winter steelhead abundance in the Van Duzen River (CDFG 2012b). The number of adult steelhead observed during a 20-mile survey of steelhead holding pools on the Van Duzen River from Eaton Roughs to Little Larabee Creek has varied since 1979. From 2011 to 2014 (next most recent year was 1997), counts have been between 81 and 255 adults with the peak in 2012, and averaged 152 fish per year (as cited in NMFS 2015, Shaun Thompson, CDFW, pers. comm. 1/22/2015). These numbers are much lower than estimates of over 2,000 fish in the Little Van Duzen alone prior to the 1964 flood (CDFG 2012a). There are an estimated 3,000-5,000 adult winter steelhead in the Van Duzen River annually (as cited in NMFS 2015, S. Downie, CDFW, pers. comm. 8/3/2012). In order to achieve a low risk of extinction, there should be at least 6,340 steelhead adults in the Van Duzen River each year.

Baseline Information for SRNF Restoration Planning

The SRNF characterizes environmental baseline information in a number of ways to guide watershed and fisheries restoration planning. In addition to the baseline information summarized above, another tool that the SRNF uses is The Matrix of Pathways and Indicators (NMFS 1996) for characterizing environmental baselines for anadromous fish habitat and predicting the effect of human activities on these conditions. The Matrix of Pathways and Indicators provides generalized ranges of functional values for aquatic, riparian and watershed elements that collectively describe properly functioning condition for aquatic habitat essential to the long-term survival of anadromous fish. Properly functioning values for these indicators generally correspond with the Aquatic Conservation Strategy objectives that are important to Pacific salmonids.

The SRNF also uses the Watershed Condition Framework (WCF) as a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands (Figure 3). The WCF was implemented across all National Forests to improve the Forest Service approach to watershed restoration by establishing a consistent methodology for condition assessment, and targeting the implementation of integrated collections of enhancement activities on those watersheds identified as priorities for restoration (USDA 2011a).

Prior to the WCF each national forest classified watershed condition (typically at the watershed, or HU5, scale) using local methods that were not consistent between forests. The WCF provides a framework for consistent assessments at the subwatershed, or HU6 scale, and for prioritizing watersheds for restoration.

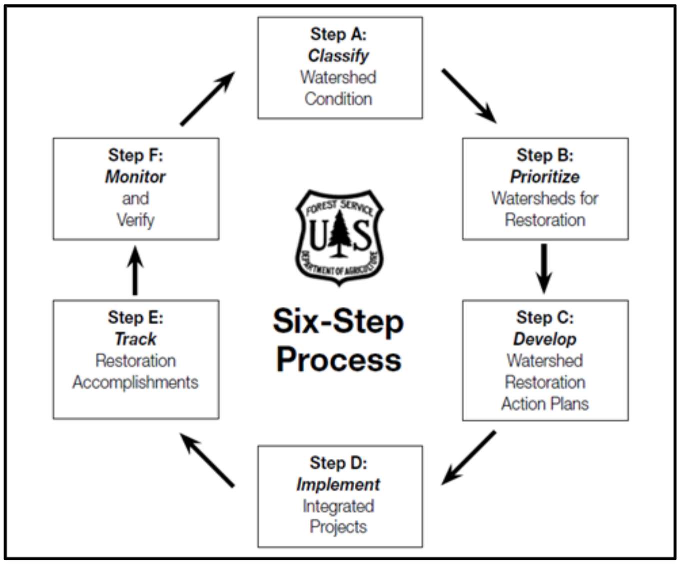

Figure 3. Six-steps of the Watershed Condition Framework Process

Watershed condition classification is the process of describing watershed condition in terms of discrete categories (or classes) that reflect the level of watershed health or integrity. The WCF classifies watershed condition using a comprehensive set of 12 indicators that are surrogate variables representing the underlying ecological, hydrological, and geomorphic functions and processes that affect watershed condition. Information from the Matrix of Pathways and Indicators, in addition to recent GIS information was used to develop values for these WCF indicators (USDA SRNF 2015).

The indicators are grouped according to four major process categories: (1) aquatic physical, (2) aquatic biological, (3) terrestrial physical and (4) terrestrial biological. These categories represent terrestrial, riparian, and aquatic ecosystem processes or mechanisms by which management actions can affect the condition of watersheds and associated resources. The four "process categories" are then weighted to reflect their relative contribution toward watershed condition from a national perspective. The aquatic physical and aquatic biological categories are weighted at 30 percent each because of their direct impact to aquatic systems (endpoint indicators). The terrestrial physical category was weighted at 30 percent because roads are one of the greatest sources of impact to watershed condition. The terrestrial biological category is weighted at 10 percent because these indicators have less direct impact on watershed condition.

Primary emphasis is placed on aquatic and terrestrial processes and conditions that Forest Service management activities can influence. The approach is designed to promote integrated watershed assessments; target programs of work in watersheds that have been identified for restoration; enhance communication and coordination with external agencies and partners; and improve reporting and monitoring of program accomplishments.

On the SRNF, there were 71 subwatersheds (6th field HUC) included in the assessment. National forest ownership within subwatersheds ranged from 5-100 percent (watersheds with less than 5 percent national forest lands were not rated). Assessment data came from the national forests so ratings apply only to the national forest lands in the watershed. Table 6 summarizes these two efforts in order to identify watersheds that may have a higher sensitivity to impacts, or a higher need for restoration actions.

Table 6. Overall Watershed Condition Ratings

Rating	Smith River	Klamath River	Salmon River	Redwood/ Mad River	Trinity River	Van Duzen River	Eel River	Totals
Functioning Properly	14	9	6	1	2	0	2	34
Functioning at Risk	1	6	0	2	5	3	8	25
Impaired Function	2	2	0	4	3	1	0	12
Totals	17	17	6	7	10	4	10	71

Environmental Baseline Summary

The SRNF has streams and rivers that currently provide habitat for Chinook salmon, coho salmon, steelhead trout, cutthroat trout, pacific lamprey, and resident rainbow trout and other aquatic species (mussels, snails, and crayfish). This habitat is on a continuum of recovery since the 1964 flood that in combination with past management activities (e.g., timber harvest) simplified the riparian areas and stream habitat. Over this same time period, a road network was developed to serve ongoing timber management priorities, including harvesting, reforestation, and stand management. With the signing of the LRMP in 1995, focus on the Aquatic Conservation Strategy has led to improved management of riparian reserves that has reduced the risk of negative impacts to stream habitats due to management actions. In addition, the SRNF has had an aggressive road decommissioning and upgrading program (see Appendix A of the BA) that has reduced the risk of flood-driven excessive sediment delivery to stream channels.

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. “Harm” is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). “Incidental take” is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

2.4 Effects of the Action

Under the ESA, “effects of the action” means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

The WFR Program is intended and designed to include project activities that will improve watershed conditions in general and to enhance salmonid habitat in the short and long term. The BA (USDA SRNF 2015) for the Program combined two effects analysis methodologies to capture the effects of restoration activities, the Matrix of Pathways and Indicators (MPI) (NMFS 1996) and the Analytic Process (USDA et al. 2004) developed by NMFS in conjunction with USFS. NMFS considered those methodologies and the information the BA provided on effects to critical habitat and the species in our exposure, response and risk analysis in this *Effects of the Action* section.

Actions involving heavy equipment operating in occupied habitat would have the potential to cause adverse impacts to individual fish or their habitat whereas actions occurring on roads would range from having no effect (road maintenance on a ridgetop road) to an adverse impact (from culvert replacements near or in occupied habitat). Activities may or may not have adverse impacts based on the proximity of the activity to listed salmonids and critical habitat, whether or not there is a causal mechanism for an impact to occur, and the environmental baseline of the habitat to absorb or withstand an impact. This analysis is documented during the NEPA process. Projects are reviewed at the Annual Coordination Meeting to ensure the site specific activity effects are tracked and that impacts stay within the bounds of the Program. Site specific determinations of the activity would be documented in the NEPA decision and on the Project Notification Form.

As described in detail in the *Proposed Action* section of this BO, the activities covered under the WFR Program include:

Fish Access to Habitat/Habitat Connectivity

1. Fish Passage Restoration – all life stages (instream/flow related, weir modification, culvert replacement) and reconnecting downstream movement of habitat components through road related actions.

Instream Habitat Enhancement

2. Large Wood and Boulder Projects
3. Gravel Augmentation
4. Legacy/Historic Structure Improvements or Removal
5. Beaver Habitat Restoration

Side-Channel/Off Channel

6. Off- and Side-Channel Habitat Restoration

Streambank Restoration

7. Streambank Restoration (including toe of landslide treatments)
8. Reduction/Relocation of Recreation Impacts
9. Livestock Fencing, Stream Crossings, and Off-Channel Livestock Watering

Riparian Restoration

10. Riparian restoration and enhancement (planting, alder girdling for conifer growth)

11. Non-native Invasive Plant Control

Road Related Actions

12. Road and Trail Erosion Control (road/trail maintenance, and stormproofing)

13. Decommissioning Roads (including unauthorized non-system routes)

Other

14. Reduction of Impacts related to Illegal Marijuana Grow Clean up

15. Mine Reclamation

16. In-channel Nutrient Enhancement

Some of these project types result in no effect to listed fish or their habitat, such as fencing to exclude livestock from streams, and other project types result in insignificant, discountable, or wholly beneficial effects, such as riparian restoration and enhancement. Other project types, such as fish passage improvement, and gravel augmentation, result in adverse sediment effects or adverse fish handling effects. The following section describes ways in which the project activities may affect, but are not likely to adversely affect, listed species or their critical habitat.

2.4.1 Insignificant or Discountable Effects to Listed Species or Their Critical Habitat

Project activities carried out under the WFR Program may affect listed species; however, some components of the project activities also may result in effects, such as disturbance from heavy equipment operation, water temperature increases from riparian vegetation disturbance, chemical contamination of water quality, reduced benthic macroinvertebrate production and entrainment during water drafting that may affect, but are not likely to adversely affect listed species or their critical habitats. These effects are expected to be insignificant or discountable as explained further below.

<u>Noise, Motion, and Vibration Disturbance from Heavy Equipment Operation and Pile Driving</u>

Noise, motion, and vibration produced by heavy equipment operation is expected at most instream restoration sites. However, the use of equipment, which will occur primarily outside the active channel, and the infrequent, short-term use of heavy equipment in the wetted channel to construct cofferdams or to cross the wetted channel, is expected to result in insignificant effects to listed coho salmon and steelhead. Due to project timing that restricts heavy equipment use to the summer (i.e., heavy equipment operations proposed to begin after June 15 each year, and post June 30 for heavy equipment entry to the wetted channel), juvenile coho salmon and steelhead that are rearing near heavy equipment operations will be mature enough to avoid interaction with instream machinery by temporarily relocating either upstream or downstream into suitable habitat adjacent to the worksite. No other species or life stages are expected to be exposed. In addition, the annual maximum number of instream projects, and the upper limits on how many instream projects that can occur in a watershed in a single year of the Program (see

Table 2, Upper Limits on Activities), would further reduce the potential of an aggregated effect of heavy equipment disturbance on listed salmonids.

Beaver habitat restoration activities could also occur within occupied habitat, leading to the potential for noise/vibration impacts to occur through pile driving. Wooden spikes would be driven into the gravel bed using the bucket of a backhoe or through use of a hydraulic posthole driver, both which could generate noise. The number of posts placed would be dependent on the stream width and the number of rows placed. Halvorson et al (2012) examined the risk of pile driving and seismic exploration on Chinook salmon exposed to the impulsive sound. Impulsive sounds are those that last for a short period of time and include frequencies over a large portion of the acoustic spectrum, such as a hammer blow or hand clap. Based on a review of literature by Hastings and Popper (2005) the degree of damage is not related directly to the distance of the fish from the pile, but to the received level and duration of the sound exposure. Laboratory data for a variety of sound sources have been used to estimate the thresholds of effects of pile driving on fish. However, there have been few experiments that evaluate pile driving sound propagation and attendant physical effects of pile driving sound on fish in natural environments, particularly in riverine systems.

CalTrans used caged fish deployments within the Mad River (California) to expose juvenile steelhead (*Onchorhynchus mykiss*) to a variety of peak sound pressures levels (SPLs) and cumulative sound exposure levels (SELs) from 2.2-meter-diameter (7.2-foot-diameter) cast-insteel-shell (CISS) piles driven immediately adjacent to the Mad River (CalTrans 2010). In this one study, on-site necropsies of all exposed and control fish conducted following each trial, as well as histopathology of the fish from the cages closest to the pile driving and control fish, showed no physical trauma that could be related to exposure to underwater noise from pile driving, and no statistically significant differences between experimental and control animals were detected. Similarly, hematocrit and plasma cortisol levels were not significantly related to exposure to noise generated by pile driving. In summary, there were no immediate significant physical effects of exposure to peak SPLs or cumulative SELs of ≤194 dB from pile driving at the project site.

Coho salmon and steelhead juveniles would be able to disperse away from the areas with pile driving occurring. In addition, since the posts being used in beaver habitat restoration would be out of wood, the noise and vibration level would be significantly less than the steel pile driving used by CalTrans (NMFS 2014). Therefore, physical or behavioral responses from juvenile coho salmon and steelhead due to pile driving would be insignificant.

Increased Water Temperature from Disturbance to Riparian Vegetation

Most proposed WFR Program actions are expected to avoid disturbing riparian vegetation through the avoidance and minimization measures, project design features and BMPs. In general, the restorative nature of these projects is to improve habitat conditions for salmonids, and thus, riparian vegetation disturbance that is incidental to the project objective (e.g., clearing riparian vegetation to decommission a road-stream crossing to reduce sediment risk) is expected to be avoided or minimized. However, alder girdling that is intended to enhance conifer growth will remove alders from riparian areas. In addition, sources of LW for instream improvement projects includes very selective cutting of conifer trees in riparian areas.

Alder girdling treatments and cutting or pulling/pushing live conifers and other trees over in the riparian area for in-channel large wood placement can only occur when vegetation in the riparian area is fully stocked (USDA SRNF 2015). Fully stocked means that there are sufficient standing trees such that individually selected trees could be cut or pulled over (for the root wad) without affecting the stand characteristics, including canopy cover. Because canopy cover is not affected by these activities, we do not expect water temperatures to increase as the level of canopy coverage and shade will remain approximately the same as before the riparian treatment. Also, selecting individual trees out of riparian areas for instream placement would not change the future canopy cover. Riparian treatments designed to improve riparian conditions in the long term (alder girdling and planting), may result in a slight change to canopy cover as alders die. This small increase in solar radiation to the stream channel would be localized to small areas of alter treatments, and no change in stream temperature would result at the reach level.

In addition, the upper limits on activities will result in few places in each watershed where trees will be felled for sources of LW, and alder girdling will be staggered along stream channels, with treatment areas being small patches (less than one-half acre in size) of dense hardwood stands. Thus, increases in water temperature from riparian restoration are expected to be discountable.

Chemical Contamination from Equipment Fluids

Equipment refueling, fluid leakage, and maintenance activities within and near the stream channel pose some risk of contamination. Toxic chemicals associated with construction equipment can adversely affect water quality and may harm listed salmonids or their critical habitat. However, all projects included in the WFR Program will include the measures outlined in the *Proposed Action* sections entitled, *Heavy Equipment Use* and *Site Assessment for Contaminants*. Given that: 1) all equipment will be fueled outside of the riparian reserves (with some exceptions due to topography), 2) equipment will be checked for leaks before operations and daily during operations and 3) spill response kits are to be included with all equipment, only small amounts of hazardous fluids have the potential to leak, or be delivered to the wetted channel. Due to the proposed protection measures that reduce the risk of petroleum product entry to the wetted channel and the potential size of a leak, and proposed measures that allow for a quick response to a potential leak, effects to juvenile or adult salmonids or water quality from equipment fueling or chemical fluid leaks are expected to be insignificant.

Reduced Benthic Macroinvertebrate Community

Benthic (*i.e.*, bottom dwelling) aquatic macroinvertebrates may be temporarily lost or their abundance reduced when stream habitat is dewatered (Cushman 1985), as may occur for fish passage or road decommissioning activities. Effects to aquatic macroinvertebrates resulting from stream flow diversions and dewatering will be temporary because instream construction activities occur only during the low flow season, and rapid recolonization (about one to two months) of disturbed areas by macroinvertebrates are expected following re-watering (Cushman 1985, Thomas 1985, Harvey 1986). In addition, the effect of macroinvertebrate loss on juvenile coho salmon, or steelhead is likely to be negligible because food from upstream sources (via drift) would be available downstream of the dewatered areas because stream flows will be maintained around the project work site. Based on the foregoing, the effect of temporarily reduced food availability for juvenile coho salmon and steelhead resulting from dewatering activities is discountable.

Entrainment or Impingement Due to Water Drafting

Water drafting may occur under the WFR Program, primarily in association with road maintenance activities. Water drafting sites may be located within occupied coho salmon and steelhead habitat. Water drafting operations can disturb holding or spawning adult fish, as well as impinge or entrain juveniles (Sicking 2003). Additionally, water drafting operations can mobilize suspended sediment to nearby downstream aquatic habitat. Suspended sediment increases turbidity, exposing juvenile fish to gill damage and reduced oxygen uptake, and/or reduced vision and compromised feeding effectiveness. Due to screening the intakes adult fish will not be exposed to effects from water drafting. Minimization of impingement requires the use of specific mesh sizes, pumping rates, and sufficiently large screen areas, as outlined in the NMFS Water Drafting Specifications (2001b), which will be followed as part of the WFR Program. There is a very low probability of impingement given that fish have been routinely observed to temporarily move away from a drafting pump site when a truck or hose is detected (USDA SRNF 2015). In addition, based on SRNF observations (K. Kenfield USFS, pers. comm. 2015), it is anticipated that fish temporarily avoiding water drafting activities are not likely to experience reduced feeding success, nor be exposed to a significantly higher probability of exposure to prey, as they will have suitable habitat to utilize away from the water drafting site.

Water drafting can result in minor, short-term and localized decreases in flow, especially in smaller streams, affecting water quantity and quality. This is particularly true during drought conditions, which may occur during project implementation. However, NMFS 2001b specifications don't allow drafting volumes to exceed 10 percent of stream flow within fish-bearing streams, to allow for adequate downstream flow to support fish, aquatic insects, amphibians, and other biota. Additionally, SRNF fish biologists will be consulted prior to water drafting operations so that they can ensure that sites with rearing coho salmon and steelhead are avoided and sites that are not suitable for fish (primarily due to high stream temperatures) are prioritized for use. Due to project design features that have been designed to minimize reductions in stream flow and associated changes to water quality, and the requirement to adhere to NMFS 2001b water drafting specifications that greatly reduce the possibility of entrainment or impingement, effects from water drafting on juvenile coho salmon and steelhead are expected to be insignificant.

2.4.2 Adverse Effects to Listed Species

Collectively, the WFR Program has the potential to result in adverse effects to listed species and their habitat. Increased suspended sediment may occur from in-channel construction activities and erosion from upslope road decommissioning projects. Harm or mortality may occur from fish handling during fish passage improvement and in-channel restoration activities. Crushing of fish may occur during heavy equipment use in-stream. In this section we identify the direct and indirect adverse effects of the proposed action on the listed species, their designated critical habitat, or both. The species and designated critical habitat that may be exposed and the anticipated responses will vary depending on the location of each individual habitat restoration project site.

Effects could occur through three potential pathways:

1. Fish may be incidentally injured or killed by all WFR Program activities involving heavy equipment, including pile driving posts for beaver restoration in occupied habitat.

2. Projects that occur in occupied habitat may involve isolation, capture, handling, transport, and relocation of coho salmon and steelhead. Fish handling has the potential to result in fish injury or death.
3. Project results in sediment entering occupied habitat such that individuals' behavior is significantly altered, or harm occurs.

Individual restoration projects conducted under the WFR Program that include instream construction activities will be implemented during low flow periods between June 15 and November 1, or first significant rainfall, whichever comes first (however, equipment cannot enter the wetted channel until after June 30 in order to protect steelhead fry). The specific timing and duration of each individual restoration project will vary depending on the project type, specific project methods, and site conditions. However, the duration and magnitude of effects to listed salmonids and to salmonid critical habitat associated with implementation of individual restoration projects will be significantly minimized due to the multiple proposed avoidance and minimization measures, SRNF standards and guidelines, and BMPs.

Implementing individual restoration projects during the summer low-flow period will minimize exposure to emigrating coho salmon and steelhead smolts, and will avoid exposure to immigrating coho salmon adults at all restoration project sites. The total number of projects and the location of individual projects authorized through the Program annually will vary from year to year depending on various factors, including funding and scheduling, but in all cases will be limited by upper limits of activities described in the *Proposed Action* section and summarized in Table 2.

Despite the different scope, size, intensity, and location of project activities covered under the WFR Program, the potential adverse effects to listed salmonids and their habitat result from dewatering, fish relocation, crushing and increased sediment. Dewatering, fish relocation, and structural placement (causing crushing) will result in direct effects to listed salmonids, where a very small percentage of juvenile coho salmon or steelhead will be injured or killed. The effects from increased sediment mobilization into streams are usually indirect effects, where the effects to habitat, individuals, or both, are reasonably certain to occur and are later in time.

Dewatering

Although in-stream project types, such as fish passage improvement, large wood and boulder placement, and road decommissioning include the possibility of dewatering, not all individual project sites will need to be dewatered, based on site conditions and location of project site within the watershed. Based on proposed upper limits on project activities, a maximum of 6 projects per year could occur Forest-wide that could require dewatering and fish relocation. When dewatering is necessary, only a small reach of stream at each project site will be dewatered for instream construction activities. Dewatering encompasses placing temporary barriers, such as a cofferdam, to hydrologically isolate the work area, re-routing stream flow around the dewatered area, pumping water out of the isolated work area, relocating fish from the work area (discussed separately), and restoring the project site upon project completion. Based on the maps included with the BA (USDA SRNF 2015), the length of contiguous stream reach that will be dewatered for most projects is expected to be less than 500 feet and no greater than 1000 feet for any one project site. If the diversion allows for downstream fish passage, the diversion outlet will be placed in a location to promote safe reentry of fish into the stream channel, preferably into pool habitat with cover. As described in the *Proposed Action* section, fish passage will be maintained during dewatering if possible, and fish passage will be restored to dewatered areas if they were passable prior to the dewatering.

Exposure

Because the proposed dewatering would occur during the low flow period, the species and life stages most likely to be exposed to potential effects of dewatering are juvenile coho salmon and juvenile steelhead. A few adult summer run steelhead and half-pounder steelhead, may also be exposed where these individuals are present at or near the proposed project sites, although past relocation results indicate the chances of encountering these species and life stages is very low (Flosi 2010). Dewatering is expected to occur mostly during the first half of the instream construction window (*e.g.*, to accommodate for the necessary construction time needed), and in SRNF locations that are far upstream from the coast, and therefore should avoid exposure to adult coho salmon. Adult summer steelhead and steelhead half-pounders are not likely to be exposed because adults will avoid the construction area and dewatering is very rarely done late in the low flow season.

Response

The effects of dewatering result from the placement of the temporary barriers, the trapping of individuals in the isolated area, and the diversion of streamflow. Fish relocation and ground disturbance effects are discussed in subsequent sections below. Rearing juvenile coho salmon and steelhead could be killed or injured if crushed during placement of the temporary barriers, such as cofferdams, though crushing is expected to be minimal due to evasiveness of most juveniles, and due to instream activities limited to begin after June 15, and after June 30 for entry into the wetted channel, when even late hatching steelhead are likely to have developed a flee, rather than burrow response. Stream flow diversions could harm salmonids by concentrating or stranding them in residual wetted areas (Cushman 1985) before they are relocated, or causing them to move to adjacent areas of poor habitat (Clothier 1953, Clothier 1954, Kraft 1972, Campbell and Scott 1984). Juvenile coho salmon and steelhead that are not caught during the relocation efforts could be killed from either construction activities or desiccation.

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

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

Effects associated with dewatering activities will be minimized due to the multiple minimization measures that will be utilized as described in the *Proposed Action* section. Juvenile coho salmon and steelhead that avoid capture in the project work area could die during dewatering activities. NMFS expects that the number of coho salmon, or steelhead that could be killed as a result of barrier placement and stranding during site dewatering activities is very low, likely less than one percent of the total number of salmonids in the project area. The low number of juveniles expected to be injured or killed as a result of dewatering is based on the low number of projects that require dewatering, the avoidance behavior of juveniles to disturbance, the small area affected during dewatering at each site, the low number of juveniles in the typically degraded habitat conditions common to proposed restoration sites, and the low numbers of juvenile salmonids expected to be present within each project site after relocation activities.

Fish Relocation Activities

Up to six project sites per year may require dewatering that will include fish relocation (up to three projects per year for juvenile steelhead handling and up to three projects per year for juvenile coho salmon handling). SRNF personnel (or designated agents) capture and relocate fish (and amphibians) away from the restoration project work site to minimize adverse effects of dewatering to listed coho salmon and steelhead juveniles. Fish in the immediate project area will be captured by seine, dip net and/or by electrofishing, and will then be transported and released to a suitable instream location.

Exposure

The species and life stages most likely to be exposed to fish relocation are juvenile coho salmon and steelhead. Adult coho salmon are not expected to be present at project sites during summer months, and adult summer steelhead and half-pounders are expected to avoid construction sites during in-stream construction activities.

Response

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

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

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

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

Effects associated with fish relocation activities will be significantly minimized due to the multiple minimization measures that will be utilized (see *Proposed Action* section). In addition, NMFS expects that fish relocation activities associated with implementation of individual restoration projects will only affect a very small percentage of coho salmon and steelhead exposed to fish relocation, and fish relocation will not affect the number of returning coho salmon or steelhead adults. Fish relocation activities will occur during the summer low-flow period after emigrating smolts have left the restoration project sites and before adult fish travel upstream. Therefore, the majority of listed salmonids that will be captured during relocation activities will be age-0 coho salmon and juvenile steelhead parr of various ages. Although most mortality of coho salmon and/or steelhead during fish relocation activities will occur almost exclusively at the YOY stage, there is a potential of unintentional mortality of a one- or two-year old fish.

Based on the CDFG FRGP annual monitoring reports (Collins 2004; CDFG 2006, 2007, 2008, 2009, 2010), NMFS is able to estimate the maximum number of federally listed salmonids expected to be captured, injured, and killed each year from the dewatering and relocation activities (see *Incidental Take Statement* section for numbers of individual fish mortality or injury). When estimating the maximum number of listed salmonids that are expected to be captured each year, NMFS used the CDFG FRGP monitoring reports, reducing the highest number of captured individuals to account for the lower number of projects expected to be dewatered under the WFR Program.

Structural Placement

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

Increased Mobilization of Sediment within the Stream Channel

The proposed restoration project types involve various degrees of earth disturbance. Inherent with earth disturbance is the potential to increase background suspended sediment loads for a short period during and following project completion. Many project types involving ground disturbance in or adjacent to streams are expected to increase turbidity and suspended sediment levels within the project work site and downstream areas. Therefore, instream habitat improvement, fish passage improvement, stream bank stabilizations, creation of off channel/side channel habitat, and road decommissioning may result in increased mobilization of sediment into streams. Although riparian restoration may involve ground disturbance adjacent to streams, the magnitude and intensity of this ground disturbance is expected to be small and isolated to the riparian area.

Exposure

In general, sediment-related effects are expected during the summer construction season (June 15 to November 1), as well as during peak-flow winter storm events when remaining loose sediment is mobilized. During summer construction, the species and life stages most likely to be exposed to potential effects of increased sediment mobilization are juvenile coho salmon and juvenile steelhead. As loose sediment is mobilized by higher winter flows, adult coho salmon, and steelhead may also be exposed to increased turbidity. Fish passage improvement and road-stream crossing removals associated with road decommissioning will have the greatest potential for releasing excess sediment. However, minimization measures, such as removing excess sediment from the dewatered channel prior to returning flow, and using erosion control measures and BMPs to control sediment availability, will limit the amount of sediment released. In addition, the location of road decommissioning and stormproofing projects are typically far upslope of occupied habitat, typically crossing first and second order streams (i.e., intermittent and ephemeral streams) which limits the amount of sediment that will be transported downstream into occupied habitat.

Due to the minimization measures, the location of most sediment producing projects upslope in the watershed, and based on the upper limits on the miles of road work per year, increased mobilization of sediment is not likely to degrade spawning gravel, as project related sediment mobilization far enough downstream to enter spawning habitat should be minimal. The small amount of sediment that would be transported downstream into spawning habitat is expected to be easily displaced by either higher fall/winter flows or redd building. In the winter, the high flows will carry excess fine sediment downstream to point bars and areas with slower water velocities. Because redds are built where water velocities are higher, the minimally increased sediment mobilization is not expected to smother existing redds. Therefore, salmonid eggs and alevin are not expected to be exposed to the negligible increase in sediment on redds.

Response

Restoration activities may cause temporary increases in turbidity and the deposition of excess sediment may alter channel dynamics and stability (Habersack and Nachtnebel 1995, Hilderbrand et al. 1997, Powell 1997, Hilderbrand et al. 1998). Erosion and runoff during precipitation and snowmelt will increase the supply of sediment to streams.

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

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

Yet, research investigating the effects of sediment concentration on fish density has routinely focused on high sediment levels. For example, Alexander and Hansen (1986) measured a 50 percent reduction in brook trout (*Salvelinus fontinalis*) density in a Michigan stream after manually increasing the sand sediment load by a factor of four. In a similar study, Bjornn et al. (1977) observed that salmonid density in an Idaho stream declined faster than available pool volume after the addition of 34.5 m^3 of fine sediment into a 165 m study section. Both studies attributed reduced fish densities to a loss of rearing habitat caused by increased sediment deposition. However, streams subject to infrequent episodes adding small volumes of sediment to the channel may not experience dramatic morphological changes (Rogers 2000). Similarly, research investigating severe physiological stress or death resulting from suspended sediment exposure has also focused on concentrations much higher than those typically found in streams subjected to minor/moderate sediment input (reviewed by Newcombe and MacDonald (1991) and Bozek and Young (1994)).

In contrast, the lower concentrations of sediment and turbidity expected from the proposed restoration activities are unlikely to be severe enough to cause injury or death of listed juvenile coho salmon and/or steelhead. Instead, the anticipated low levels of turbidity and suspended sediment resulting from upslope road work, and instream restoration projects will likely result in only temporary behavioral effects. Recent monitoring within Northern California detailed a range in turbidity changes downstream of newly replaced culverts following winter storm events (Humboldt County 2002, 2003 and 2004). During the first winter following construction, turbidity rates (NTU) downstream of newly replaced culverts increased an average of 19 percent when compared to measurements directly above the culvert. However, the range of increases within the 11 monitored culverts was large (n=11; range 123% to -21%). Monitoring results from one- and two-year-old culverts were much less variable (n=11; range:12% to -9%), with an average increase in downstream turbidity of one percent. Although the culvert monitoring results show decreasing sediment effects as projects age from year one to year three, a more important consideration is that most measurements fell within levels that were likely to only cause slight behavioral changes [*e.g.*, increased gill flaring (Berg and Northcote 1985), elevated cough frequency (Servizi and Marten 1992), and avoidance behavior (Sigler et al. 1984)]. Turbidity levels necessary to impair feeding are likely in the 100 to 150 NTU range (Gregory and Northcote 1993, Harvey and White 2008). However, only one of the Humboldt County measurements exceeded 100 NTU (NF Anker Creek, year one), whereas the majority (81 percent) of downstream readings were less than 20 NTU. Importantly, proposed minimization measures, some of which were not included in the culvert work analyzed above, will likely ensure that future sediment effects from fish passage projects and road decommissioning will be less than those discussed above. Therefore, the small pulses of moderately turbid water expected from the proposed instream restoration projects will likely cause only minor physiological and behavioral effects, such as dispersing salmonids from established territories, potentially increasing interspecific and intraspecific competition, as well as predation risk for the small number of affected fish.

Upslope watershed restoration activities, such as road decommissioning and upgrading, are expected to mobilize sediment through channel adjustment after crossing removal and through some sources of road surface erosion. However, these activities are generally higher up in the watersheds where the adjacent streams are typically first or second order, and are typically not fish bearing. Sediment mobilization will be minimized through road outsloping, reseeding and mulching disturbed areas, and other erosion control measures. These erosion control measures should prevent a majority of the sediment from reaching fish bearing streams. Aggregated sediment effects will be minimized by the upper limits on project activities that can be implemented in a given year.

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

Due to the measures discussed above and the upper limits on project activities, NMFS does not expect sediment effects to accumulate at downstream restoration sites within a given watershed. Sediment effects generated by each individual project will likely impact only the immediate footprint of the project site and up to approximately 1500 feet of channel downstream of the site. Studies of sediment effects from culvert construction determined that the level of sediment accumulation within the streambed returned to control levels between 358 to 1,442 meters downstream of the culvert (LaChance et al. 2008). Because of the multiple measures to minimize sediment mobilization, downstream sediment effects from the proposed restoration projects are expected to extend downstream for a distance consistent with the range presented by LaChance et al. (2008). Also, the upper limits on project activities will preclude sediment effects from accumulating at downstream project sites and the temporal and spatial scale at which project activities are expected to occur will also likely preclude significant additive sediment related effects. Finally, effects to instream habitat and fish are expected to be short-term, because most project-related sediment will likely mobilize during the initial high-flow event the following winter season. Subsequent sediment mobilization may occur following the next two winter seasons, but generally should subside to baseline conditions by the third year as found in other studies, such as Klein (2007), and suggested by the Humboldt County data (Humboldt County 2004).

Increased turbidity during the summer and fall construction season may also result in short-term behavioral changes of juvenile coho salmon and steelhead (Newcombe and Jensen 1996). Behavioral changes include changes in feeding, predator detection, and avoidance of sediment plumes up to a few hundred feet downstream of the disturbance, such that juvenile coho salmon and steelhead may temporarily be displaced into different habitat. However, the timing of each sediment plume will vary throughout the season, so that increases in turbidity and sedimentation from in-stream projects will be temporally and spatially staggered throughout the season, years of WFR Program implementation, and action area. The small area of in-stream disturbance, and the measures for limiting fine sediment delivery, will also limit exposure of habitat and individuals.

Ivanovich and Hamid (2014) reviewed information about aquatic ecosystem quality over a wide range of sediment concentrations, durations of exposure, species, life stage and severity of ill effect for fish. Using a decision tree methodology, they determined that exposure duration is the most important parameter for significant severity of ill effect predictions. Most exposed individuals will be able to relocate to nearby areas of suitable habitat for feeding and cover, but that this relocation of individuals may temporarily increase competition for resources. Given that there will only be a few instream projects per watershed, per year, and that exposure and displacement will be minimal, the fitness of only a few individual juvenile coho salmon or steelhead would decrease due to increased turbidity, displacement and increased competition/predation. A slight reduction in feeding opportunities and predator detection, and an increase in competition is expected, and that substrate quality will be slightly reduced in a few isolated places each year across the SRNF. The response of individuals will be limited by little exposure, that there is suitable habitat nearby to be displaced into, and that the small magnitude of increased turbidity from instream and streambank disturbance will be of short duration.

2.4.2 Effects to Critical Habitat

Adverse Effects to PCEs

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

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

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

Migratory habitat is essential for juvenile salmonids outmigrating to the ocean as well as adults returning to their natal spawning grounds. Migratory habitat may be affected during the temporary re-routing of the channel during project implementation, however a migratory corridor will be maintained at all times. Beaver habitat restoration has the potential to adjust and form migration blockages. However, the proposed location of beaver habitat improvements in complex channel areas with side channels will avoid migration blockages during winter high flows. The proposed monitoring and needed adjustment and maintenance of the beaver habitat structures during times of winter baseflow will minimize the potential for migration blockages during non-storm flows. Activities adding complexity to habitat will increase the number of pools, providing resting areas for adults, and the removal of barriers will increase access to habitat.

Misguided restoration efforts often fail to produce the intended benefits and can even result in further habitat degradation. Improperly constructed projects can cause greater adverse effects than the pre-existing condition. The SRNF has a long track record of successful implementation of both instream and upslope restoration projects. The SRNF has numerous standards, guidelines, BMPs and past experience to ensure proper design and construction of restoration projects. Properly constructed stream and upslope restoration projects will increase available habitat, habitat complexity, stabilize channels and streambanks, increase spawning gravels, decrease sedimentation, and increase shade and cover for salmonids. The WFR Program has been designed to limit the duration and magnitude of effects. Sediment effects are expected to remain minimal and not accumulate by implementing project design features and upper limits on activities per watershed that limit the number of, sediment producing activities; however some effects to substrate and water quality are expected due to increased sediment mobilization.

Sediment Effects to Critical Habitat

There are three potential sources for turbidity/suspended solids that enter the water column. Fine sediments from the stream bed that have been disturbed by work performed in channel; fine sediment introduced from the stream banks during restoration activities; and fine sediment that enters the stream network from upstream, typically from road/stream crossings interactions (road maintenance, culvert upgrades and decommissioning).

Suspended sediment and turbidity caused by heavy equipment entry into the wetted channel will cause a short-term (i.e., a few hours) and small (i.e., about one-half a channel width wide, extending for approximately 1500 feet downstream) plume of turbidity during the summer or early fall months when the water in the action area would otherwise be clear. When this occurs upstream of occupied habitat, the turbidity would have little to no effect until winter flows flushed the settled sediment out. During winter flows, the amount of sediment is unlikely to be distinguishable from background.

WFR Program activities such as road decommissioning and upgrading are typically upstream and upslope of occupied coho salmon or steelhead habitat, such as erosion control of roads and trails, and road decommissioning. For these types of projects, sediment is typically not transported until the first few storm events following road treatment.

The fall and winter storms of the water year (water year defined as October 1 to September 31 of each calendar year) will expose habitat to increases in suspended sediment concentrations (SSC) from both background and WFR Program activities. The first storms of the year typically have the highest relative SSC because natural erosional and human related processes produce fresh material for transport during the drier summer and early fall months. The magnitude of the SSC increases from WFR Program activities are a function of the number of channel crossings removed each year and the location of those channel crossings in relation to occupied habitat and designated critical habitat. Background levels of SSC are already high in most waterways within the action area during fall and winter storms, and we do not have an estimate of how much sediment will be released from channel crossing removal. Local monitoring of SSC in Lost Man Creek (tributary to Redwood Creek) shows that removal of upslope channel crossings caused temporary increases in SSC downstream of project sites within occupied habitat during the first winter following road decommissioning (from channel erosion adjustment at culvert removal sites). However, levels of turbidity typically returned to pre-project concentrations after the first winter following project implementation (Klein 2007). The increases in SSC downstream of channel crossing removal sites was an order of magnitude greater than background, but that the increased SSC quickly returned to background levels after the first few storms of the winter. The duration of the SSC increases are also a function of the early storms' duration; storm duration may vary, but typically storms last from a few days to about a week.

While the majority of activities have some potential to introduce sediment into the channel, road decommissioning and culvert replacements have the greatest potential for introducing sediment into the stream channel. The SRNF examined 117 km (73 miles) of decommissioned roads, including 262 stream crossings, on the Forest in northwestern California, to quantify erosion and identify failure mechanisms and potential areas for improvement. Although most crossings had experienced some adjustment, erosion was generally minor. The average amount of erosion for stream crossings was 21 m^3 (28 yd^3), which represents 4.5 percent of the amount of fill excavated. Of this volume, 40 percent of the erosion was due to channel adjustment and 60 percent was due to bank failures. Erosion from the roadbed between crossings was very small and was observed only in areas of highly unstable geology. The amount of erosion appears well correlated with the timing and intensity of storm events, as large storm events occurring the first winter after decommissioning produced elevated erosion levels. After several dry winters, erosion was very minor, even from large storm events (Cook & Dresser 2007). Keppeler et al. (2007) identified the 0-2 year period as the most significant period for sediment movement in streams after human disturbance.

Thus, short-term periods of elevated turbidity, and resulting small decreases in water and substrate quality are possible due to the WFR Program activities. The distance for sedimentation effects to dissipate to background levels is dependent on site specific environmental factors, such as channel gradient, sediment size and lithology (Lawrence et al., 2014). Because the largest source of sediment from the WFR Program is from road work in upslope locations above accessible habitat, the effect to downstream, occupied habitat will be reduced due to sediment storage and routing along the stream network. In addition, the upper limits on project activities will minimize an aggregated effect from occurring at the watershed scale.

Beneficial Effects to the PCEs

Habitat restoration projects will be designed and implemented consistent with the techniques and minimization measures described in the *Proposed Action* section to maximize the benefits of each project while minimizing effects to salmonids. Aquatic and upslope restoration projects are for the purpose of restoring degraded salmonid habitat and are intended to improve instream cover, pool habitat, spawning gravels, and water quality; remove barriers to fish passage; and reduce or eliminate erosion and sedimentation sources. Although some habitat restoration projects may cause small losses of juvenile coho salmon and steelhead in the project areas during construction, all of the projects are anticipated to improve salmonid habitat and salmonid survival and recovery over the long-term.

Instream Habitat Improvements

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

Placement of LW into streams can result in the creation of pools that influence the distribution and abundance of juvenile salmonids (Spalding et al. 1995, Beechie and Sibley 1997). LW influences the channel form, retention of organic matter and biological community composition. In small (<10 m bankfull width) and intermediate (10 to 20 m bankfull width) streams, LW contributes channel stabilization, energy dissipation and sediment storage (Cederholm et al. 1997). Presence and abundance of LWD is correlated with growth, abundance and survival of juvenile salmonids (Fausch and Northcote 1992, Spalding et al. 1995). The size of LW is important for habitat creation (Fausch and Northcote 1992).

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

Fish Passage Improvement

Human constructed physical barriers within the stream channel, such as culverts and dams can impair sediment and debris transport, migration routes, life history patterns, and population viability. Historic instream structures can also adjust such that they form low flow barriers to movement of juvenile fish. First and second order streams, which generally include permanently flowing non-fish bearing streams and seasonally flowing or intermittent streams, often comprise over 70 percent of the cumulative channel length in mountain watersheds in the Pacific Northwest (Benda et al. 1992). These streams are the sources of water, nutrients, wood, and other vegetative material for streams inhabited by fish and other aquatic organisms (Swanson et al. 1982; Benda and Zhang 1990). Decoupling the stream network (through physical barriers) can result in the disruption and loss of functions and processes necessary for creating and maintaining fish habitat. Further, physical barriers prevent the movement of fish in their fulfillment of life history functions. Culverts, for instance, prevent juvenile fish from reaching rearing habitats (Furniss et al. 1991) and have blocked significant amounts of historical anadromous salmonid habitat (Roni et al. 2002). Even more, barriers restrict the expression of various life history forms within a species.

On SRNF, no Forest Service roads are known to block movement of adult or juvenile fish species. Bridges are located at all road stream crossings where anadromous fish are found. County and state roads may still form barriers. With the potential of steelhead to surpass historic barriers (Eaton Falls) Forest Road/stream crossings would need to be reevaluated on the upper Van Duzen.

In addition to man-made barriers, low flow conditions at the mouths of tributaries (influenced by illegal and legal water diversions) may prevent juvenile fish from reaching cool water refugia. The legacy structure/maintenance or removal category contains two subcategories that will target fish passage restoration through old structures that may be preventing movement of individuals at low flows. Removing or fixing these historic structures would allow for uninhibited stream access for migrating and rearing fish. Culvert upgrades, while not causing fish passage concerns, would result in restored or improved continuous paths for wood, nutrients, sediments, and other vegetative material essential for quality fish habitat.

Stream Bank Stabilization

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

Upslope Watershed Restoration

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

Water Quality

In general, the WFR Program will improve or restore one or more of the following: stream structure/complexity, stream sinuosity and length, bank stability, floodplain connectivity, and riparian vegetation structure and diversity. Such results will promote conditions that maintain or decrease stream temperature (via increased shading and hyporheic flow), reduce turbidity (via stable banks, improved sediment retention through increased channel structure, riparian areas, and floodplains), and improved nutrient input (via increased riparian allocthonous sources and nutrient supplementation) and retention (via increased channel structure, sinuosity, and floodplain areas).

Salmon Derived Nutrients

Restoration efforts use the rationale of declining SDN to justify artificial nutrient additions, with the goal of reversing salmon decline. Biological responses to this method have also been documented (Roni et al. 2002). Elevated primary production and density of invertebrates have been associated with carcass additions (Wipfli et al. 1999). Kohler et al. (2012) documented that invertebrate productivity and fish growth increased after carcass analog treatments in several Columbia River Basin streams. While evidence suggests that fish and wildlife may benefit from increases in food availability as a result of carcass additions, stream ecosystems vary in their ability to use nutrients to benefit salmon.

2.5 Cumulative Effects

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

State, tribal, local, or private actions that may affect listed species within the action area include private land timber and grazing management and suppression of wildfires. However, the most common private activity likely to occur in the action area is un-regulated recreation and illegal marijuana grows.

Un-regulated Recreation and Marijuana Grows

Although recreational activities on the SRNF are managed to some degree (*i.e.*, campgrounds, trailheads, off-road-vehicle trails), a considerable amount of dispersed unmanaged recreation occurs. Expected impacts to coho salmon and steelhead from this type of un-regulated recreation includes minor releases of suspended sediment, impacts to water quality, and short-term barriers to fish movement. Streambanks, riparian vegetation, and spawning redds can be disturbed wherever human use is concentrated. Unpermitted marijuana grows also occur on and near SRNF lands. These grows often divert water from nearby tributaries, depleting water quantity, and negatively affecting water quality in downstream occupied habitat.

Timber Harvest and Livestock Grazing

Timber harvest and grazing are likely to continue to have an influence on environmental conditions within the action area for the indefinite future. However, these industries have adopted management practices that avoid or reduce many of their most harmful impacts, such as the California Department of Forestry Forest Practice Rules that includes protection measures for salmonids and their habitat.

Timber management and grazing on private lands is more prevalent downstream of the action area, since that is where the bulk of private lands occur. Future timber harvest levels in the action area cannot be predicted; however, it is assumed that, for the foreseeable future, levels will be within the approximate range of those occurring since the listing of the northern spotted owl in 1992. Between 1992 and 2011 for the counties within the action area, the average annual harvest volume was 894 million board feet (MMBF), with most of the harvest occurring in Humboldt, Mendocino, and Siskiyou Counties. It is assumed similar trends in harvest will continue. Livestock grazing on private lands within the action area is also likely to continue at similar to current levels during the duration of the Program.

Suppression and Control of Wildfires

CalFire will likely be involved in the suppression or control of wildfires in the action area during the duration of the proposed Program. Future levels of suppression or control of wildfires in the action area cannot be predicted; however, it is assumed that, for the foreseeable future, levels will be steady or increasing. Federally controlled suppression activities would be consulted on through emergency consultation.

2.6 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the WFR Program. In this section, we add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5), taking into account the status of the species and critical habitat (section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species.

SONCC coho salmon populations throughout the action area have shown a dramatic decrease in both numbers and distribution and do not occupy some of the streams where they were found historically. Both the presence-absence and trend data available for SONCC coho salmon suggest that many populations in the larger basins (*e.g.*, Eel and Klamath) continue to decline. The poor condition of their habitat in many areas and the compromised genetic integrity of some stocks pose a serious risk to the survival and recovery of SONCC coho salmon. Based on the above information, recent status reviews have concluded that SONCC coho salmon are likely to become endangered in the foreseeable future. The Recovery Plan for SONCC Coho Salmon (NMFS 2014) describes that most populations are currently at high extinction risk due to low population abundance levels. The Recovery Plan also describes the stresses and threats to the species and includes recovery actions to abate those stresses and threats.

Steelhead populations throughout northern California have also shown a decrease in abundance, but are still widely distributed throughout most of the DPS. Although NC steelhead have experienced significant declines in abundance, and long-term population trends suggest a negative growth rate, they have maintained a better distribution overall when compared to the SONCC coho salmon ESU. This suggests that, while there are significant threats to the population, they possess a resilience (based in part, on a more flexible life history) that likely slows their decline. However, the poor condition of their habitat in many areas and the compromised genetic integrity of some stocks pose a risk to the survival and recovery of NC steelhead. Summer-run steelhead are especially vulnerable to poor instream habitat conditions and are at high extinction risk throughout the species range (NMFS 2015). Based on the above information, recent status reviews and available information indicate NC steelhead are likely to become endangered in the foreseeable future. The public draft Multispecies Recovery Plan (NMFS 2015) includes information on extinction risk and stress and threat abatement.

Currently accessible salmonid habitat throughout the action area has been degraded, and the condition of designated critical habitats, specifically their ability to provide for long-term salmonid conservation, has also been degraded from conditions known to support viable salmonid populations. Intensive land and stream manipulation during the past century (*e.g.*, logging, agricultural/livestock development, mining, urbanization, and river dams/diversion) has modified and eliminated much of the historic salmonid habitat in northern California. Impacts of concern include alteration of stream bank and channel morphology, alteration of water temperatures, loss of spawning and rearing habitat, fragmentation of habitat, loss of downstream recruitment of spawning gravels and LWD, degradation of water quality, removal of riparian vegetation resulting in increased stream bank erosion, increases in erosion entry to streams from upland areas, loss of shade (higher water temperatures), and loss of nutrient inputs (61 FR 56138). Due to federal ownership and management, the action area has more productive stream habitat than many of the more coastal, urban and industrial areas, however much of the action area is upstream and upslope of accessible habitat for salmonids. As National Forest lands within the range of the Northwest Forest Plan, the action area is managed with the objective of obtaining late seral forest habitat and providing habitat for listed species.

Although projects authorized under the WFR Program are for the purpose of restoring anadromous salmonid habitat and watershed function, some take of listed salmonids will likely result from fish relocation activities, crushing, and the temporary effects of sediment mobilization and deposition. NMFS anticipates only small numbers of juvenile coho salmon and/or steelhead may be adversely affected at each individual restoration project work site, and downstream of road decommissioning and stormproofing projects. Adverse effects from sediment to listed salmonids are expected to be in the form of short-term, sub-lethal behavioral effects. Salmonids present during project construction may be disturbed, displaced, injured or killed by project activities, and salmonids present in the project work area will be subject to capture, relocation, and related stresses. Unintentional mortalities of coho salmon and/or steelhead during fish relocation activities and dewatering will occur exclusively at the juvenile stage. NMFS anticipates the effects of individual restoration projects and of implementation of the WFR Program as a whole will not reduce the number of returning listed salmonid adults, and may increase the number of adults through improvements in habitat quality and quantity. The WFR Program has been designed to implement the NMFS Recovery Plans, improve habitat and increase population viability.

Short-term impacts to salmonid habitat from restoration activities will be minimal and mostly localized at each project site, with small and temporary decreases in water quality and substrate occurring downstream of project sites due to project generated turbidity. The duration and magnitude of effects to designated critical habitat associated with implementation of restoration projects will be significantly minimized due to the multiple project design features and BMPs that will be utilized during implementation. The upper limits on activities included in the proposed action will minimize significant additive effects and NMFS expects that spawning, rearing and migratory habitat in the action area will improve over the life of the 15-year Program.

NMFS has determined these effects are not likely to appreciably reduce the numbers, distribution or reproduction of coho salmon and/or steelhead within each watershed where restoration projects occur. This is based on the upper limits of activities per year and per watershed, the low number of projects that result in direct effects to salmonids, and the minor short-term effects resulting from increased turbidity levels. All of the restoration projects are intended to restore degraded salmonid habitat and improve instream cover, pool habitat, and spawning gravel; remove barriers to fish passage and watershed function; and reduce or eliminate erosion and sedimentation impacts. Although there will be short-term impacts to salmonid habitat associated with a small percentage of projects implemented annually, NMFS anticipates most projects implemented will provide long-term improvements to salmonid habitat. NMFS also anticipates that the additive beneficial effects to salmonid habitat over the 15-year period of the Program should improve local instream salmonid habitat conditions for multiple life stages of salmonids and should improve survival of local populations of salmonids into the future. Restored habitat resulting from restoration projects should improve adult spawning success, juvenile survival, and smolt outmigration, which will in turn lead to improved abundance, productivity, spatial structure, and diversity within the watershed population.

2.7 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of SONCC coho salmon or destroy or adversely modify its designated critical habitat. It is also NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of NC steelhead or destroy or adversely modify its designated critical habitat.

2.8 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

2.8.1 Amount or Extent of Take

NMFS expects a few specific types of projects implemented under the WFR Program (see *Effects* section) will result in incidental take of listed SONCC coho salmon and NC steelhead during the 15-year Program. Juvenile coho salmon and steelhead will be harmed, injured, or killed from the fish handling, fish relocation, dewatering and instream construction activities. Although adults will sometimes also be present when the instream construction activities occur, no take of adults is expected. Incidental take is expected to be in the form of capture during dewatering and fish relocation activities, from crushing during instream construction activities and from sub-lethal behavioral effects during periods of increased turbidity generated by Program activities.

Fish Handling, Relocation and Dewatering

NMFS expects no more than 613 juvenile SONCC coho salmon will be annually captured, 0.6 percent of the captured coho salmon will be injured each year, and 0.6 percent of the captured coho salmon will be killed each year (Table 8). NMFS expects no more than 1201 juvenile NC steelhead will be annually captured, 0.7 percent of the captured steelhead will be injured each year, and 0.6 percent of the captured steelhead will be killed each year (Table 8).
Data from salmonid relocation efforts since 2004 show most mortality rates are below three percent (Collins 2004, 2005; CDFG 2006, 2007, 2008, 2009, 2010). Based on this data, NMFS is able to estimate the maximum number of federally listed salmonids expected to be captured, injured, and killed during each year of the 15 years in which fish relocation is proposed (Table 7). When estimating the maximum number of listed salmonids that are expected to be captured each year, NMFS used the CDFG FRGP monitoring reports, reducing the highest number of captured individuals by a factor of 5 to account for the lower number of projects expected to be dewatered under the proposed WFR Program (Table 8). NMFS used the highest percentage recorded under the FRGP program to estimate the percent of each species that would be injured or killed each year (Table 8). As a result, NMFS expects that (1) no more than 613 juvenile SONCC coho salmon will be captured, 0.6 percent of the captured coho salmon will be injured, and 0.6 percent of the captured coho salmon will be killed annually; and (2) no more than 1,201 juvenile NC steelhead will be captured, 0.7 percent of the captured steelhead will be injured, and 0.6 percent of the captured steelhead will be killed annually (Table 8). An adult equivalent killed per year due to dewatering activities was calculated for coho salmon and steelhead using a conservatively estimated average smolt to adult survival ratio of 0.02 (Smoker et al 2004, Scheuerell and Williams 2005).

Table 7. Dewatering and relocation information for CDFG FRGP Program

Species	**Year**	**# Projects in Humboldt County**	**# Projects Dewatered**	**# Captured**	**# Injured**	**% Injured**	**# Killed**	**% Killed**
Coho	2002	21	3	0	-	-	-	-
Coho	2003	42	8	8	-	-	0	0.00
Coho	2004	123	10	0	-	-	-	-
Coho	2005	158	17	344	2	0.58	2	0.58

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

Table 8. Estimated maximum number of salmonids that will be captured, injured, or killed due to fish handling, relocation, and dewatering under the proposed WFR Program

Species	**Max. # Individuals Captured/Yr ***	**Max. % Injured/ Yr**	**Max. # Individuals Injured/Yr**	**Max. % Killed/Yr**	**Max. # Individuals Killed/Yr**	**Adult Equivalent Killed/Yr**
Coho	613	0.6	4	0.6**	4	<1 (0.08)
Steelhead	1201	0.7	8	0.6	7	<1 (0.14)

*Maximum number of individuals captured per year calculated from highest data point in Table 7 and divided by five to account for lower rate of dewatered projects
**The highest data point (4.35%) in Table 7 was excluded as an outlier
***Because the previous data (Table 7) resulted in 0% injured or killed, NMFS will conservatively expect one or less individual injured or killed per year.

Structural Placement

A few juvenile coho salmon and steelhead may be injured or killed during large structural placements or structural placements that cover a large area, such as gravel augmentation, full channel construction, or during brief heavy equipment usage in the wetted channel. Proposed upper limits on activities and many minimization measures associated with these types of activities reduce the number of individuals at risk of crushing. Based on the upper limits of activities (see *Proposed Action* section), project timing that is limited to post June 30 for instream work, and low densities of juvenile coho salmon and steelhead at sites needing habitat restoration, NMFS estimates that a maximum of 15 juvenile coho salmon and 30 juvenile steelhead will be crushed by heavy equipment, placement of large woody debris, gravel augmentation, or full channel construction during each year of the restoration program. We anticipate more juvenile steelhead than juvenile coho salmon will be crushed because they have been found to be more likely to use a burrow response and data show their density is likely to be greater than that of juvenile coho salmon (Humboldt County and Stillwater Sciences 2011).

Increased Sediment

Instream construction activities may increase turbidity for short durations during the summer, and upslope road decommissioning will add to background turbidity during the first winter following road decommissioning projects. We expect impairment of essential behavior patterns as a result of short-term increases in turbidity and fine sediment, which may affect water quality, feeding, and sheltering. These reductions in habitat will temporarily increase competitive pressures on the affected individuals and may result in slightly decreased growth rates and slightly lower ocean survival of juveniles. Overall, we anticipate that the number of juvenile coho salmon and steelhead harmed will be low and no individuals will die due to temporary increases in turbidity.

The proposed restoration project types involve various degrees of instream construction disturbance, which will be staggered spatially and temporally over the action area (see *Proposed Action* section on upper limits on activities per watershed per year). Inherent with the disturbance is the potential to increase background suspended sediment loads for a short period during and following project completion within the immediate project footprint and up to approximately 1,500 feet of channel downstream of the instream construction site. During project implementation of instream construction activities within occupied coho salmon or steelhead habitat, turbidity should be visually monitored during in-channel work to ensure that the turbidity plume remains less than the entire channel width and less than 1,500 feet downstream of the project. Summer turbidity plumes should dissipate quickly, within a few hours. If actions cause turbidity to exceed these conditions, the activity must be ceased and additional minimization measures must be put into place until the turbidity conditions are met. In addition to summer turbidity plumes associated with instream construction activities, upslope road decommissioning will result in increased downstream turbidity during the first winter after project implementation. This increase in winter turbidity will be delivered to occupied habitat during storm events with already turbid conditions. We expect that the small amount of sediment generated from upslope activities that is delivered to downstream habitat will not increase turbidity from already sub-lethal ranges, and will result in minor behavioral effects to coho salmon and steelhead individuals.

As described in the *Effects* section, the SRNF has monitored response of decommissioned roads to post-implementation erosion. The SRNF will also continue to monitor and participate in the Monitoring and Reporting Program (MRP) associated with the Categorical Waiver of Waste

Discharge Requirements for Nonpoint Source Discharges on National Forest Lands Order Number R1-2010-0029 (Waiver) (USDA SRNF 2015). The terms and conditions of the Waiver stipulate a monitoring and reporting program that assesses water quality on the SRNF. We expect that the extent of take associated with winter turbidity will be consistent with the previous level of post-implementation erosion from road decommissioning projects (e.g., similar levels of channel adjustment and surface erosion).

2.8.2 Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to SONCC coho salmon or NC steelhead, or the destruction or adverse modification of their critical habitats.

2.8.3 Reasonable and Prudent Measures

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

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

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

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

4. Measures shall be taken to ensure that fish passage is provided and maintained after implementation of beaver habitat improvement projects.

2.8.3 Terms and Conditions

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

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

a. Fish relocation data must be provided annually. Any injuries and mortality from a fish relocation site that exceeds one percent[8] of a listed species shall be reported to the nearest Arcata NMFS office within 48 hours and relocation activities shall cease until the SRNF and NMFS determine how to decrease injury or mortality to less than one percent.

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

a. The SRNF shall provide NMFS annual notification of projects that are carried out under the WFR Program as described in Appendix F of the BA (USDA SRNF 2015), and in the *Proposed Action* section of this opinion. The annual notification shall be submitted to NMFS during the Annual Level 1 Coordination during the first quarter of each calendar year (usually January).

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

- A summary detailing fish relocation activities, including the number and species of fish relocated and the number and species injured or killed. Any capture, injury, or mortality of adult salmonids or half-pounder steelhead will be noted in the monitoring data and report. Any injuries or mortality from a fish relocation site that exceeds one percent of the listed species shall have an explanation describing why.
- The number and type of instream structures implemented within the stream channel.
- The length of streambank (feet) stabilized or planted with riparian species.
- The number of culverts replaced or repaired, including the number of miles of restored access to unoccupied salmonid habitat.
- The distance (miles) of road decommissioned.
- The distance (feet) of occupied aquatic habitat disturbed at each project site.
- A summary of previous years' channel adjustments and surface erosion estimates from previous decommissioned road projects carried out under the WFR Program.

This report shall be submitted annually during the Level One Annual Coordination Meeting between the SRNF and NMFS.

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

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

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

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

   a. All beaver habitat improvement projects within occupied habitat shall be visually monitored by SRNF fisheries biologists during winter baseflow conditions to determine if fish passage is provided. If fish passage is not being provided, the structure will be modified to provide for passage.

2.9 Reinitiation of Consultation

This concludes formal consultation for SRNF WFR Program.

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

2.10 "Not Likely to Adversely Affect" Determination

NMFS does not anticipate that the proposed action will adversely affect CC Chinook salmon.

Proposed Action and Action Area
The proposed action and action area are described in the *Introduction* section (Sections 1.3 and 1.4 respectively) of this document. In summary, the proposed action is implementation of 16 categories of restoration activities covered under the WFR Program and intended to improve watershed conditions and habitat for salmonids.

Action Agency's Effects Determination
The SRNF determined that CC Chinook salmon will not be adversely affected by activities carried out under the WFR Program because the distribution of CC Chinook salmon does not occur on U.S. Forest Service land within the action area. Where the CC Chinook salmon ESU does overlap USFS lands, large instream barriers exist on the Van Duzen, Mad and North Fork

Eel rivers that prevent Chinook salmon distribution in areas where actions are proposed to occur (Refer to *Environmental Baseline*, Section 2.3 for additional information).

Consultation History
Consultation History is described in the *Introduction* to this document, Section 1.2.

ENDANGERED SPECIES ACT

Chinook salmon are not currently able to migrate upstream to SRNF lands in the Mad River, North Fork Eel River, or the Van Duzen River. Based on interviews done with longtime residents of the North Fork Eel, Keter (1995) determined that Chinook salmon historically were found in the North Fork Eel, but are now blocked by the split rock barrier downstream of SRNF lands. Chinook salmon are present in the mainstem Eel River, including Dobbyn Creek. However, distribution in Dobbyn Creek is limited to those areas downstream of the SRNF boundary. CC Chinook salmon critical habitat reaches up on to SRNF lands in the North Fork Dobbyn Creek, but distribution of the species does not occur on SRNF lands in North Fork Dobbyn Creek.

Effects of the Action
Under the ESA, "effects of the action" means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action (50 CFR 402.02). The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. The *Effects of the Action* section of this document (section 2.4) describes the effects of the WFR Program in detail. Three pathways for adverse effects are expected from the proposed action: (1) mortality or injury due to dewatering and fish handling, (2) crushing due to instream work, and (3) increases in summer and winter suspended sediment.

Because CC Chinook salmon are not found in streams on SRNF lands, they will not be exposed to dewatering, handling, or crushing, thus these effects from the WFR Program are discountable for CC Chinook salmon. Chinook salmon will also not be exposed to increases in suspended sediment resulting from WFR Program activities during the summer, thus effects from summertime increases in turbidity are also discountable due to the localized nature and close proximity of increases in suspended sediment to the action area (i.e., sediment plumes that are localized to within 1500 of the project activity).

Suspended sediment resulting from adjustment of decommissioned roads during the first winter after project completion will not be measurable within the range of CC Chinook salmon, because the natural barriers to their migration are located many miles downstream of upslope road projects on the SRNF. Thus CC Chinook salmon will not be exposed to WFR Program generated increases in winter turbidity. The designated critical habitat found in North Fork Dobbyn Creek could be in closer proximity to road decommissioning projects, but the maps included with the BA for the WFR Program (USDA SRNF 2015) do not indicate a dense road network within this sub-watershed. Thus, the critical habitat could be exposed to minor and short term increases in suspended sediment during the winter, but due to the upslope location of road projects, the current road network in the sub-watershed and limits on project activities described in the *Proposed Action* section of the BO, we expect effects of increased suspended sediment on stream habitat to be insignificant.

Conclusion

Based on this analysis, NMFS concurs with the SRNF that the proposed action is not likely to adversely affect listed CC Chinook salmon and its designated critical habitat.

Reinitiation of Consultation

Reinitiation of consultation is required and shall be requested by SRNF or by NMFS, where discretionary Federal involvement or control over the action has been retained or is authorized by law and (1) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (2) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this concurrence letter; or if (3) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR 402.16). This concludes the ESA portion of this consultation.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the U.S. Forest Service and descriptions of EFH for Pacific coast salmon (PFMC 1999) contained in the fishery management plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in this document. The action area includes areas designated as EFH for various life-history stages of Pacific coast salmon.

3.2 Adverse Effects on Essential Fish Habitat

Based on information provided in the BA (USDA SRNF 2015) and the analysis of effects presented in the ESA portion of this document, NMFS concludes that the proposed action will have the following adverse effect to EFH designated for Pacific coast salmon.

1. Freshwater EFH quantity will be temporarily reduced due to short-term releases of suspended sediment and increases in turbidity during and directly following project activities covered under the WFR Program.

3.3 Essential Fish Habitat Conservation Recommendations

NMFS does not propose any additional conservation recommendations beyond the U.S. Forest Service Standards and Guidelines, and Best Management Practices previously mentioned in the BO and included in the BA (USDA and USDI 1994, SRNF/KNF 1995, USDA SRNF 2015), and the additional minimization measures proposed for each category of activity under the WFR Program (USDA SRNF 2015).

3.4 Supplemental Consultation

The U.S. Forest Service 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.

5.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the Six Rivers National Forest. Other interested users could include permit applicants, citizens of affected areas, others interested in the conservation of the affected ESUs/DPS, contractors performing project work. Individual copies of this opinion were provided to the Six Rivers National Forest. This opinion will be posted on the Public Consultation Tracking System web site (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). The format and naming adheres to conventional standards for style.

5.2 Integrity

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

5.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

5. REFERENCES

Ackerman, N.K., B. Pyper, I. Couter and S. Cramer. 2006. Estimation of returns of naturally produced coho to the Klamath River - Review Draft. Technical Memorandum #1 of 8. Klamath Coho Integrated Modeling Framework Technical Memorandum Series. Submitted to the Bureau of Reclamation Klamath Basin Area Office on November 2

Alexander, G.R., and E.A. Hansen. 1986. Sand bed load in a brook trout stream. No. Am. J. Fish. Manage. 6:9-23.

Armour, C.L. 1990. Guidance for evaluating and recommending temperature regimes to protect fish. U.S. Fish and Wildlife Service. Fort Collins. Biological Report 90(22). 13 p.

Barr, B. R., M. E. Koopman, C. D. Williams, S. J. Vynne, R. Hamilton, and B. Doppelt. 2010. Preparing for climate change in the Klamath basin. National Center for Conservation Science and Policy and The Climate Leadership Initiative. http://www.geosinstitute.org/images/stories/pdfs/Publications/ClimateWise/KlamathBasinCFFReport_Final_Long_20100901.pdf

Bartholow, J. M. 1995. Review and analysis of Klamath River basin water temperatures as a factor in the decline of anadromous salmonids with recommendations for mitigation. River Systems Management Section, Midcontinent Ecological Science Center, U. S. National Biological Service, Fort Collins, Colorado. Final draft.

Bartholow, J. M. 2005. Recent Water Temperature Trends in the Lower Klamath River, California. North American Journal of Fisheries Management 25:152-162.

Bartson, A.P. 1997. Restoration strategy for the fisheries of the Smith River. Draft. Institute for River Ecosystems, Humboldt State University, Arcata, California. 96 p.

Battin, J., M. W. Wiley, M. H. Ruckelshaus, R. N. Palmer, E. Korb, K. K. Bartz, and H. Imaki. 2007. Projected impacts of climate change on salmon habitat restoration. PNAS 104(16):6720-6725. doi:10.1073/pnas.0701685104

Bauer S, Olson J, Cockrill A, van Hattem M, Miller L, Tauzer M, et al. 2015. Impacts of Surface Water Diversions for Marijuana Cultivation on Aquatic Habitat in Four Northwestern California Watersheds. PLoS ONE 10(3): e0120016. doi:10.1371/journal. pone.0120016

Beechie, T.J., D.A. Sear, J.D. Olden, G.R. Pess, J.M. Buffington, H. Moir, P. Roni, and M.M. Pollock. 2010. Process-based Principles for Restoring River Ecosystems. Bioscience 60:209-222.

Beechie, T.J., H. Imaki, J. Greene, A. Wade, H. Wu, G. Pess, P. Roni, J. Kimball, J. Stanford, P. Kiffney and N. Mantua. 2013. Restoring Salmon Habitat for a Changing Climate. River Research and Applications. 29: 939-960.

Beechie, T.J. and T.H. Sibley. 1997. Relationships between channel characteristics, woody debris, and fish habitat in northwestern Washington streams. Trans. Am. Fish. Soc. 26:217-229.

Bell, E. and W.G. Duffy. 2007. Previously undocumented two-year freshwater residency of juvenile coho salmon in Prairie Creek, California. Transactions of the American Fisheries Society 136: 966-970.

Bell, E., W. G. Duffy, and T. D. Roelofs. 2001. Fidelity and survival of juvenile coho salmon in response to a flood. Transactions of the American Fisheries Society 130:450-458.

Benda, L. and W. Zhang. 1990. The hydrological and geomorphological characteristics of landslide/dam break floods in the Cascade Range of Washington. EOS, Transactions of the American Geophysical Union.

Benda, L., Beechie, T.J., Wissmar, R.C., and A. Johnson. 1992. Morphology and evolution of salmonid habitats in a recently deglaciated river basin, Washington State, USA. Can, J. Fish. Aqua. Sc. 49:1246-1256.

Berg, L. and T.G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Onchorhynchus kisutch*) following a short-term pulses of suspended sediment. Can. J. Fish. Aqua. Sc. 42:1410-1417.

Bestcha, R.L. and W.S. Platts. 1986. Morphological features of small streams: significance and function. Water Resources Bulletin 22(3):369-379

Bisson, P.A., R.E. Bilby, M.D. Bryant, C.A. Dolloff, G.B, Grette, R.A. House, M.L. Murphy, K.V. Koski, and J.R. Sedell. 1987. Large woody debris in forested streams in the Pacific Northwest: past, present, and future. In. Salo, E.O.; Cundy, T.W., eds. Streamside management: forestry and fishery interactions. Seattle, Washington: University of Washington, Institute of Forest Resources: 143-190.

Bjorkstedt, E.P., B.C. Spence, J. C. Garza, D.G. Hankin, D. Fuller, W.E. Jones, J. J. Smith, and R. Macedo. 2005. An analysis of historical population structure for Evolutionarily Significant Units of Chinook salmon, coho salmon, and steelhead in the North-Central California Coast Recovery Domain. NOAA Technical Memorandum NMFS-SWFSC-382: 1-210. US Department of Commerce, La Jolla, California. October.

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

Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. American Fisheries Society Publication 19. 83-138.

Boberg, J. 2008. Personal communication. Biologist. U.S. Forest Service. Six Rivers National Forest, Eureka, California.

Bozek, M.A., and M.K. Young. 1994. Fish mortality resulting from the delayed effects of fire in the greater Yellowstone ecosystem. Great Basin Naturalist 54:91-95.

Bradford, M.J., and J.R. Irvine. 2000. Land use, fishing, climate change, and the decline of Thompson River, British Columbia, coho salmon. Can. J. Fish. Aquat. Sci. 57:13-16

Brown, T.G. and G.F. Hartman. 1988. Contribution of Seasonally Flooded Lands and Minor Tributaries to the Production of Coho Salmon in Carnation Creek, British Columbia. Transactions of the American Fisheries Society. 117:6. 7 pages

Brown, L.R. and P.B. Moyle. 1991. Status of coho salmon in California. Report to the National Marine Fisheries Service. Department of Wildlife and Fisheries Biology, University of California at Davis.

Brown, W.M., III, and J.R. Ritter. 1971. Sediment transport and turbidity in the Eel river basin. U.S. Geological Survey Water Supply Paper. 70 p.

Brown, L.R., P.B. Moyle, and R.M. Yoshiyama. 1994. Historical Decline and Current Status of Coho Salmon in California. North American Journal of Fisheries Management. Vol. 14, No. 2, p 237-261.

Brownell, N.F., W.M. Kier, and M.L. Reber. 1999. Historic and current presence and absence of coho salmon, *Onchorhynchus kisutch*, in the northern California portion of the Southern Oregon-Northern California Evolutionarily Significant Unit. Prepared for NMFS Southwest Fisheries Science Center. Kier Associates.

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

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memo. NMFS-NWFSC-27.

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

California Department of Fish and Game (CDFG). 1993. Comments on the draft action plan for restoration of the South Fork Trinity River watershed and its fisheries. Inland Fisheries Division, Sacramento. 45 p.

California Department of Fish and Game (CDFG). 2002. Status review of California coho salmon north of San Francisco. Report to the California Fish and Game Commission. Candidate Species Status Review Report 2002-3.

California Department of Fish and Game. 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission. 594 pp. Copies/CDs available upon request from California Department of Fish and Game, Native Anadromous Fish and Watershed Branch, 1416 9th Street, Sacramento, CA 95814, or on-line: http://www.dfg.ca.gov/nafwb.cohorecovery

California Department of Fish and Game (CDFG). 1965. California fish and wildlife plan. State of California Resources Agency, Department of Fish and Game. Vols. I, II and III B.

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

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

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

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

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

California Department of Fish and Game (CDFG). 2012a. California coho distribution layer. July 10. Redding. Available from: http://www.calfish.org/DataampMaps/CalFishDataDownloads/tabid/93/Default.aspx

California Department of Fish and Game (CDFG). 2012b. Van Duzen River Watershed Assessment: Public Review Draft. May. Coastal Watershed Planning and Assessment Program.

Caltrans. 2010. Necropsy and Histopathology of Steelhead Trout Exposed to Steel Pile Driving at the Mad River Bridges, U.S. Highway 101, July 2009. Prepared by G. D. Marty, DVM, Ph.D., Fish Pathology Services, Abbotsford, British Columbia, Canada.

Campbell, R.N.B., and D. Scott. 1984. The determination of minimum discharge for 0+ brown trout (*Salmo trutta L*.) using a velocity response. New Zealand Journal of Marine and Freshwater Research 18:1-11.

Cederholm, C.J. and N.P. Peterson. 1985. The retention of Coho salmon (*Onchorhynchus kisutch*) carcasses in spawning streams. Canadian Journal of Fisheries and Aquatic Sciences 42:1222-1225.

Cederholm, C.J., R.E. Bilby, P.A. Bisson, T.W. Bumstead, B.R. Fransen, W.J. Scarlett, and J.W. Ward. 1997. Response of juvenile coho salmon and steelhead to placement of large woody debris in a coastal Washington stream. No. Am. J. Fish. Manage.

Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Trans. Am. Fish. Soc. 17:1-21.

Chapman, D. W., and T. C. Bjornn. 1969. Distribution of salmonids in streams with special reference to food and feeding. Pages 153–176 in T. G. Northcote, editor. Symposium on salmon and trout in streams. H. R. MacMillan Lectures in Fisheries, University of British Columbia, Vancouver.

Clothier, W.D. 1953. Fish loss and movement in irrigation diversions from the west Gallatin River, Montana. J. Wildl. Manage. 17:144-158.

Clothier, W.D. 1954. Effect of water reductions on fish movement in irrigation diversions. J. Wildl. Manage. 18:150-160.

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

Compton, J.E., C.P. Andersen, D.L. Phillips, R. Brooks, M.G. Johnson, M.R. Church, W.E.Hogsett, M.A. Cairns, P.T. Rygiewicz, B.C. McComb, and C.D. Shaff. 2006. Ecological and water quality consequences of nutrient addition for salmon restoration in the Pacific Northwest. Frontiers in Ecology and the Environment 4(4):18-26.

Cook, C. A. and A. Dresser. 2007. Erosion and Channel Adjustments Following Forest Road Decommissioning, Six Rivers National Forest, in M Furniss, C Clifton, and K Ronnenberg, eds., 2007. Advancing the Fundamental Sciences: Proceedings of the Forest Service National Earth Sciences Conference, San Diego, CA, 18-22 October 2004, PNWGTR-689, Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

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

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

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

Crispin, V., R. House, and D. Roberts. 1993. Changes in instream habitat large woody debris and salmon habitat after restructuring of a coastal Oregon stream. North American Journal of Fisheries Management 13:96-102.

Crouse, M.R., C.A. Callahan, K.W. Malueg, and S.E. Dominguez. 1981. Effects of fine sediments on growth of juvenile coho salmon in laboratory streams. Trans. Am. Fish. Soc. 110:281-286.

CSWRCB (California State Water Resources Control Board). 2003. 2002 Clean Water Act section 303(d) list of water quality limited segments. California Regional Water Quality Control Board, Sacramento, California.

Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. No. Am. J. Fish. Manage.
North American Journal of Fisheries Management 5:330-339.

Cyr, L. 2008. Personal communication. District Fish Biologist. U.S. Forest Service, Six Rivers National Forest, Orleans Ranger District, Orleans, California.

Deas M. L., and G. T. Orlob. 1999. Klamath River Modeling Project. Project #96-HP-01. Assessment of Alternatives for Flow and Water Quality Control in the Klamath River below Iron Gate Dam. Report No. 99-04 University of California, Davis

Downie, S. 2010. Personal communication. Senior Biologist Supervisor. California Department of Fish and G

Dunne, T. and L.B. Leopold. 1978. Water in Environmental Planning. W.H. Freeman and Co., San Francisco, CA: 818 pp.

Ebersole, J.L., M.E. Colvin, P.J. Wigington Jr., S.G. Leibowitz, J.P. Baker, M.R. Church, J.E. Compton, B.A. Miller, M.A. Cairns, B.P. Hansen, and H.R. LaVigne. 2009. Modeling stream network-scale variation in coho salmon overwinter survival and smolt size. Transactions of the American Fisheries Society 138: 564-580.

Elder, D., B. Olson, A. Olson, J. Villeponteaux, and P. Brucker. 2002. Salmon River subbasin restoration strategy: Steps to recovery and conservation of aquatic resources. Report prepared for the Klamath River Basin Fisheries Restoration Task Force and U.S. Fish and Wildlife Service, Yreka, California. 53 p.

Elmore, W. and R.L. Bestcha. 1987. Riparian areas: perceptions in management. Rangelands 9(6):260-265.

Everest, L. 2008. Personal communication. Fish Biologist. U.S. Forest Service, Weaverville, California

Everest, F.H.; Bestcha, R.L.; Scrivener, J.C.; Kiski, K.V.; Sedell, J.R.; Cederholm, C.J. 1987. Fine sediment and salmonid production: a paradox. In. Salo, E.O.; Cundy, T.W., eds. Streamside management: forestry and fishery interactions. Contribution 57. Seattle, Washington: University of Washington, Institute of Forest Resources. 98-142.

Fausch, K.D. and T.G. Northcote. 1992. Large woody debris and salmonid habitat in a small coastal British Columbia stream. Canadian Journal of Fisheries and Aquatic Sciences 49:682-693.

FEMAT. 1993. Forest ecosystem management: An ecological, economic, and social assessment. Report of the Forest Ecosystem Management Assessment Team (FEMAT). 1993-793-071. U.S. Government printing Office.

Flosi, G. 2010. Personal communication. Senior Biologist Supervisor, CDFG. Northern California North Coast Region Fisheries Restoration Grant Program. Fortuna, California.

Fowler W.B., Anderson T.D., Helvey J.D. 1988. Changes in Water Quality and Climate after Forest Hazards in Central Washington. USDA Forest Service Research Paper. PNW-RP-388 Portland

Furniss, M.J., T.D. Roelofs, and C.S. Yee. 1991. Road construction and maintenance. Pages 297-324 in W. R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. Amer. Fish. Soc. , Spec, Pub. 19, Bethesda, Maryland.

Furniss, Michael J.; Roby, Ken B.; Cenderelli, Dan; Chatel, John; Clifton, Caty F.; Clingenpeel, Alan; Hays, Polly E.; Higgins, Dale; Hodges, Ken; Howe, Carol; Jungst, Laura; Louie, Joan; Mai, Christine; Martinez, Ralph; Overton, Kerry; Staab, Brian P.; Steinke, Rory; Weinhold, Mark. 2013. Assessing the vulnerability of watersheds to climate change: results of national forest watershed vulnerability pilot assessments. Gen. Tech. Rep. PNW-GTR-884. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 32 p. plus appendix.

Garling, D. L. and M. Masterson. 1985. Survival of Lake Michigan Chinook salmon eggs and fry incubated at three temperatures. Prog. Fish-Culturist 47:63-66.

Garwood, J. 2012. Historic and Recent Occurrence of Coho Salmon (*Oncorhynchuskisutch*) in California Streams within the Southern Oregon/Northern California Evolutionarily Significant Unit. Unpublished California Department of Fish and Game Report. Fisheries Branch Administrative Report, 2012-03.

Gerstung, E. R. 2001. The status and management of summer steelhead in Redwood Creek – Draft. Department of Fish and Game, Sacramento, California.

Gende SM, Edwards RT, Willson MF, and Wipfli MS. 2002. Pacific salmon in aquatic and terrestrial ecosystems. BioScience.

Geppert, R.R., Lorenz, C.W., and Larson, A.G. 1984. Cumulative Effects of Forest Practices on the Environment: A State of the Knowledge. Wash. For. Practices Board Proj. No. 0130, Dept. of Natural Resources, Olympia, Wash.

Gleick, P.H. and E.L. Chalecki. 1999. The impacts of climatic changes for water resources of the Colorado and Sacramento-San Joaquin river basins. J. Am. Water Resour. Assoc. 35:1429-1441.

Good, T.P., R.S. Waples, and P. Adams, (editors). 2005. Updated status of federally listed ESUs of west coast salmon and steelhead. West Coast Salmon Biological Review Team. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-NWFSC-66. 598 p.

Gregory, R.S., and T.G. Northcote. 1993. Surface, planktonic, and benthic foraging by juvenile Chinook salmon (*Oncorhynchus tshawytcha*) in turbid laboratory conditions. Can. J. Fish. Aquat. Sci. 50:233-240.

Gregory, S.V., F.J. Swanson, W.A. McKee, and K.W. Cummins. 1991. An ecosystem perspective of riparian zones. Bioscience 41:540-551.

Habera, J.W., R.J. Strange, B.D. Carter, and S.E. Moore. 1996. Short-term mortality and injury of rainbow trout caused by three-pass AC electrofishing in a southern Appalachian stream. No. Am. J. Fish. Manage. 11:192-200.

Habera, J.W., R.J. Strange, and A.M. Saxton. 1999. AC electrofishing injury of large brown trout in low-conductivity streams. No. Am. J. Fish. Manage. 19:120-126.

Habersack, H. and H.P. Nachtnebel. 1995. Short-term effects of local river restoration on morphology, flow field, substrate and biota. Regulated Rivers: Research & Management 10(3-4):291-301.

Halvorsen MB, Casper BM, Woodley CM, Carlson TJ, Popper AN (2012) Threshold for Onset of Injury in Chinook Salmon from Exposure to Impulsive Pile Driving Sounds. PLoS ONE 7(6): e38968. doi:10.1371/journal.pone.0038968

Hamlet, A.F. and D.P. Lettenmaier. 1999. Columbia River Streamflow Forecasting Based on ENSO and PDO Climate Signals. J. of Water Resour. Plann. Manage. 125(6):333-341.

Hamlet, A.F., P.W. Mote, M.P. Clark, and D.P. Lettenmaier. 2005. Effects of temperature and precipitation variability on snowpack trends in the western United States. J. Clim. 18:4545-4561.

Harr, R.D., W.C. Harper, J.T. Krygier, and F.S. Hsieh. 1975. Changes in storm hydrographs after road building and clear cutting in the Oregon Coast Range. Water Resources Research 11(3):436-444.

Hartman, G. F. 1965. The role of behavior in the ecology and interaction of underyearling coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*). Journal of the Fisheries Research Board of Canada 22: 1,035–1,081.

Harvey, B.C. 1986. Effects of suction gold dredging on fish and invertebrates in two California streams. No. Am. J. Fish. Manage. 6:401-409.

Harvey, B., Aquatic Ecologist, Pacific Southwest Research Station *Pers. Communication:*

Harvey, B. C., and J. L. White. 2008. Use of benthic prey by salmonids under turbid conditions in a laboratory stream. Transactions of American Fisheries Society 137:1756-1763.

Hastings, M. C. & Popper, A. N. 2005. The effects of sound on fish. California Department of Transportation Contract 43A0139 Task Order, 1. Available at http://www.dot.ca.gov/hq/env/bio/files/Effects_of_Sound_onFish23Aug05.pdf

Hayes, M.L. 1983. Active Capture Techniques. *In* L.A. Nielsen and D.L. Johnson (Editors), Fisheries Techniques. American Fisheries Society. Bethesda, Maryland, pp. 123-146

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

Healy, M. C. 1991. Life history of Chinook salmon (*Oncorhynchus tshawytscha*). Pages 311-393 in C. Groot, and L. Margolis, editors. Pacific salmon life histories. UBC Press, Vancouver, BC.

Heede, B.H. 1985. Channel adjustments to the removal of log steps: an experiment in a mountain stream. Environ. Manage. 9:427-432.

Hecht, B., and G.R. Kamman. 1996. Initial Assessment of Pre- and Post-Klamath Project Hydrology on the Klamath River and Impacts of the Project on instream Flows and Fishery Habitat. Balance Hydrologics, Inc. March.

Hicks, B.J., J.D. Hall, P.A. Bisson, and J.R. Sedell. 1991. Responses of salmonid to habitat change. Pages 483-518. In: Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. W.R. Meehan (editor). American Fisheries Society. Bethesda, Maryland.

Higgins, P.T., S. Dobush, and D. Fuller. 1992. Factors in Northern California Threatening Stocks with Extinction. Humboldt Chapter of American Fisheries Society. Arcata, CA. 25pp.

Hilderbrand, R.H., A.D. Lemly, C.A. Dolloff, and K.L. Harpster. 1997. Effects of large woody debris placement on stream channels and benthic macroinvertebrates. Can. J. Fish. Aquat. Sci. 54:931-939.

Hilderbrand, R.H., A.D. Lemly, C.A. Dolloff, and K.L. Harpster. 1998. Design considerations for large woody debris placement in stream enhancement projects. No. Am. J. Fish. Manage. 18(1):161-167.

Humboldt County. 2002. Memo from Ann Glubczynski, County of Humboldt Public Works, to Margaret Tauzer, National Marine Fisheries Service, entitled “2002 Monitoring Report – Five Fish Passage Enhancement Projects.” June 27. 1 p.

Humboldt County. 2003. Memo from Ann Glubczynski, County of Humboldt Public Works, to Margaret Tauzer, National Marine Fisheries Service, entitled “2003 Monitoring Report – Eleven Culvert Replacements for Fish Passage.” June 23. 2 pp.

Humboldt County. 2004. Memo from Ann Glubczynski, County of Humboldt Public Works, to Margaret Tauzer, National Marine Fisheries Service, entitled “2004 Monitoring Report – Eleven Culvert Replacements for Fish Passage.” June 10. 2 pp.

Humboldt County Public Works Department (County) and Stillwater Sciences. 2011. Biological Assessment for Levee Maintenance Operations in Lower Redwood Creek, Humboldt County, California. Prepared by Humboldt County Public Works Department, Eureka, California and Stillwater Sciences, Arcata, California. February. 76 p.

Hurlburt, G.G. 2013. Hall Creek, Mad River fish passage mitigation. Final report, California Department of Fish and Wildlife Grant #723006. Caltrans reference EA 01-296124.

Ivanovich, E. V., K. Hamid. 2014. An Alternative Approach for Assessing Sediment Impact on Aquatic Ecosystems Using Single Decision Tree (SDT). Journal of Water Sustainability 4(3): 181-204. DOI: 10.11912/jws.2014.4.3.181-204

Jahn, J. 2010. Personal communication. Fisheries Biologist, National Marine Fisheries Service, Southwest Region, Santa Rosa, California.

Jones, J.A. and G.E. Grant. 1996. Cumulative effects of forest harvest on peak stormflow in the western cascades of Oregon. Water Resources Research 32(4):959-974.

Jong, W.H. and T. Mills. 1992. Anadromous salmonid escapement studies, South Fork Trinity River, 1984 through 1990. Klamath-Trinity Program Inland Fisheries Division. Unpublished Administrative Report. 26 p.

Keller, E.A., A. Macdonald, T. Tally, and N.J. Merrit. 1985. Effects of large organic debris on channel morphology and sediment storage in selected tributaries of Redwood Creek, Northwest California. Geomorphic processes and aquatic habitat in the Redwood Creek basin, Northwestern California. U.S. Geological Survey. Professional Paper 1454-P. P1-P29. http://www.waterboards.ca.gov/water_issues/programs/tmdl/records/region_1/2003/ref962.pdf

Kenfield, K. 2014-2015. Personal communication. Fisheries Biologist, USDA Forest Service, Eureka, CA.

Keppeler, E.T., P. H. Cafferata, and W. T. Baxter. 2007. State Forest Road 600: A Riparian Road Decommissioning Case Study in Jackson Demonstration State Forest. California Department of Forestry and Fire Protection. Sacramento, CA.

Keter, T. 1995. Environmental history and cultural ecology of the North Fork of the Eel Basin, California. USDA Forest Service, Pacific Southwest Region, R5-EM-TP-002. 116 p.

King, J.G. and Tennyson, L.C. 1984. Alteration of streamflow following road construction in north central Idaho. Water Resour. Res., 20: 1159-1163.

Kiparsky, M. and P.H. Gleick. 2003. Climate change and California water resources: a survey and summary of the literature. Pacific Institute for Studies in Development, Environment, and Security, Oakland, California. California Energy Commission. Report 500-04-073, Sacramento, CA

Klein, R. 2007. Erosion and Turbidity Monitoring in Lost Man Creek, Redwood National and State Parks, Water years 2003-2007. Redwood National and State Parks. August, 2007

Klein, Randy. 2008. Erosion, Sediment Delivery, and Turbidity from Sanctuary Forest Stream Crossing Excavations in the Upper Mattole River Basin, 2005-2008. Technical Report. DOI: 10.13140/2.1.1005.3765

Knowles, N., and D. R. Cayan. 2004. Elevational dependence of projected hydrologic changes in the San Francisco Estuary and watershed. Climatic Change 62: 319-336.

Kohler, A.E., T.D. Pearsons, J.S. Zendt, M.G. Mesa, C.L. Johnson, and P.J. Connolly. 2012. Nutrient Enrichment with Salmon Carcass Analogs in the Columbia River Basin, USA: A Stream Food Web Analysis. Transactions of the American Fisheries Society 141 (3):802-824.

Koski, K.V. 2009. The fate of coho salmon nomads: the story of an estuarine-rearing strategy promoting resilience. Ecology and Society 14(1): 4.

Kraft, M.E. 1972. Effects of controlled flow reduction on a trout stream. J. Fish. Resour. Board Can. 29:1405-1411.

LaChance, S., M. Dube, R. Dostie, and P. Berube. 2008. Temporal and spatial quantification of fine-sediment accumulation downstream of culverts in brook trout habitat. Trans. Am. Fish. Soc. 137:1826-1838. http://dx.doi.org/10.1890/13-0753.1

Lawrence, D. J., B. Stweart-Koster, J. D. Olden, A. S. Ruesch, C. E. Torgersen, J. J. Lawler, D. P. Butcher, and J. K. Crown. 2014. The interactive effects of climate change, riparian management, and a nonnative predator on stream-rearing salmon. *Ecological Applications* 24: 895-912.

Leopold, L. 1994. A View of a River. Cambridge, MA: Harvard University Press.

Lindley, S.T., R.S. Schick, E. Mora, P.B. Adams, J.J. Anderson, S. Greene, C. Hanson, B. May, D. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science 5: Article 4.

Lisle, T.E. 1989. Sediment transport and resulting deposition in spawning gravels, North Coastal California. Water Resources Research 25(6):1303-1319.

Loyd, D.S., Koenings, J.P. and J.D. LaPerriere. 1987. Effects of turbidity in fresh waters of Alaska. N. Amer. J. Fish. Manage. 7:18-33.

Luers, A.L., Cayan, D.R., and G. Franco. 2006. Our Changing Climate, Assessing the Risks to California. A summary report from the California Climate Change Center. 16 pp.

MacDonald, L.H., Smart, A.W., and Wissmar, R.C. 1991. Monitoring Guidelines to Evaluate Effects of Forestry on Streams in the Pacific Northwest and Alaska. EPA 910/9-91-001, USEPA, Water Division, Region 10, Seattle, Wash.

Madej, M.A. 2001. Erosion and sediment delivery following removal of forest roads. Earth Surf. Processes Landforms 26:175-190.

Mason, J. C. 1976. Some features of coho salmon (*Oncorhynchus kisutch*) fry emerging from simulated redds and concurrent changes in photobehavior. Fishery Bulletin 74: 167–175.

Mayer, T. 2008. Analysis of trends and changes in Upper Klamath Lake hydroclimatology. United States Fish and Wildlife Service. Water Resources Branch. Portland, Oregon. 31 pp.

McCaffery, M., T.A. Switalski, and L. Eby. 2007. Effects of road decommissioning on stream habitat characteristics in the South Fork Flathead River, Montana. Trans. Am. Fish. Soc. 136:553-561.

McCullough, D.A. 1999. A Review and Synthesis of Effects of Alterations to the Water Temperature Regime on Freshwater Life Stages of Salmonids, with Special Reference to Chinook Salmon. Prepared for the U.S. Environmental Protection Agency, Region 10, Seattle, Washington. EPA 910-R-99-010.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-42. Seattle. 156 p.

McEwan, D. and T.A. Jackson. 1996. Steelhead restoration and management plan for California. California Department of Fish and Game, Inland Fisheries Division. 244 p.

McLeod, R.F. and C.F. Howard. 2010. January 7, 2010 Mill Creek Fisheries Monitoring Program Final Report. Mill Creek Fisheries Monitoring Program Funded by California Department of Fish and Game Fisheries Restoration Grants Program. Grantee Agreement No. P0610530.

McMahon, T. E., and G. F. Hartman. 1989. Influence of cover complexity and existing velocity on winter habitat use by juvenile coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 46: 1,551–1,557.

Meehan, W. (ed.) 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19. Bethesda MD. 751 pp.

Meehan, W. R. and T. C. Bjornn. 1991. Salmonid distributions and life histories. American Fisheries Society Special Publication 19: 47–82.

Megahan, W.F. 1982. Channel sediment storage behind obstructions in forested drainage basins draining the granitic bedrock of the Idaho batholith. In: Swanson, [and others]. Sediment budgets and routing in forested drainage basins. General Technical Report PNW-141. Portland, Oregon: USDA Forest Service, Pac. NW. Res. St. 114-121.

Meyer, K. A., and J. S. Griffith. 1997. Effects of cobble-boulder substrate configuration on winter residency of juvenile rainbow trout. North American Journal of Fisheries Management 17: 77-84.

Miles, E.L., A.K. Snover, A.F. Hamlet, B. Callahan, and D. Fluharty. 2000. Pacific Northwest regional assessment: the impacts of climate variability and climate change on the water resources of the Columbia River basin. J. Am. Water Resour. Assoc. 36:99-420.

Miller, S. A., S. N. Gordon, P. Eldred, R. M. Beloin, S. Wilcox, M. Raggon, H. Andersen, and A. Muldoon. 2015. Northwest Forest Plan-the first 20 years (1994-2013): Watershed Condition status and trend (DRAFT). Gen. Tech Rep. PNW-GTR-XXX. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Montgomery, D.R., J.M. Buffington, R.D. Smith, K.M. Schmidt, and G. Pess. 1995. Pool spacing in forest channels. Water Resources Research 31:9.

Morley, S. A., P. S. Garcia, T. R. Bennett, and P. Roni. 2005. Juvenile salmonid (Oncorhynchus spp.) use of constructed and natural side channels in Pacific Northwest rivers. Can. J. Fish. Aquat. Sci. 62(12):2811–2821.

Mote, P. W. 2006. Climate-Driven Variability and Trends in Mountain Snowpack in Western North America. Journal of Climate 19: 6209-6220.

Mote, P. W., A. F. Hamlet, M. P. Clark, and D. P. Lettenmaier. 2005. Declining mountain snowpack in western North America. Bull. Amer. Meteor. Soc. 86:39-49.

Moyle, P.B. 2002. Inland fishes of California. University of California Press, Berkeley, California. Pages 195-204.

Moyle, P.B., J.A. Israel, and S.E. Purdy. 2008. Salmon, steelhead, and trout in California: status of an emblematic fauna. University of California, Davis. Available: www. caltrout.org/SOS-Californias-Native-Fish-Crisis-Final-Report.pdf.

Murphy, M.L., and W.R. Meehan. 1991. Stream ecosystems. Pages 17-46. In: Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. W.R. Meehan (editor). American Fisheries Society. Bethesda, Maryland.

Murphy, G.T. and L. Shapovalov. 1951. A preliminary analysis of northern California salmon and steelhead runs. California Fish and Game 37:497-507.

Myers, J. M., R. G. Kope, G. J. Bryant, D. Teel, L. J. Lierheimer, T. C. Wainwright, W. S. Grant, F. W. Waknitz, K. Neely, S. T. Lindley, and R. S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memo. NMFS-NWFSC-35.

Naiman, R.J., Beechie, TJ., Benda, L.E., Berg, D.R., Bisson, P.A., MacDonald, P.A., O'Connor, M.D., Olson, P.L., and E.A. Steel. 1992. Fundamental elements of ecologically healthy watersheds in the Pacific Northwest coastal ecoregion. In: Naiman, R.J., ed. Watershed management: balancing sustainability and environmental change. New York, NY: Springer-Verlag. 127-188 p.

Newcombe, C.P., and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: A synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16:693-727.

Newcombe, C.P., and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. N. Am. J. Fish. Manage. 11:72-82.

Nickelson, T.E., J.W. Nicholas, A.M. McGie, R.B. Lindsay, D.L. Bottom, R.J. Kaiser, and S.E. Jacobs. 1992. Status of anadromous salmonids in Oregon coastal basins. Oreg. Dep. Fish. Wildl., Res. Develop. Sect. and Ocean Salmon Manage., 83 p. (Available from Oregon Department of Fish and Wildlife, P. O. Box 59, Portland, OR 97207.)

Nielson, J.L., C. Gan, and W.K. Thomas. 1994. Differences in genetic diversity for mitochondrial DNA between hatchery and wild populations of Oncorhynchus. Can. J. Fish. Aquat. Sci. 51:290 297.

National Marine Fisheries Service. 1996. Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale. National Marine Fisheries Service, Environmental and Technical Services Division, Habitat Conservation Branch.

National Marine Fisheries Service. 2001a. Status review update for coho salmon (*Oncorhynchus kisutch*) from the Central California Coast and the California Portion of the Southern Oregon/Northern California Coast Evolutionarily Significant Units. Southwest Fisheries Science Center, Santa Cruz, California. April 12. 43 p.

National Marine Fisheries Service. 2001b. Water Drafting Specifications. Southwest Region. Santa Rosa. Accessed online at: http://www.westcoast.fisheries.noaa.gov/publications/hydropower/water_drafting_specification_guidelines.pdf

National Marine Fisheries Service. 2005. Updated status of federally listed ESUs of west coast salmon and steelhead. Prepared by the Northwest Fisheries Science Center Seattle, Washington, June 2005. NOAA Technical Memorandum NMFS-NWFSC-66.

National Marine Fisheries Service (NMFS). 2006. Historical Population Structure of Coho Salmon in the Sothern Oregon / Northern California Coasts Evolutionarily Significant Unit. NOAA-TM-NMFS-SWFSC-390.

National Marine Fisheries Service. 2007. Magnuson-Stevens Reauthorization Act Klamath River Coho Salmon Recovery Plan. Prepared by Rogers, F. R., I. V. Lagomarsino and J. A. Simondet for the National Marine Fisheries Service, Long Beach, CA. 48 pp.

National Marine Fisheries Service. 2008. Endangered Species Act Section 7(a)(2) Consultation Biological Opinion And Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation: Consultation on Remand for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10 (a)(1)(A) Permit for Juvenile Fish Transportation Program (Revised and reissued pursuant to court order, *NWF v. NMFS*, Civ. No. CV 01-640-RE (D. Oregon)). NOAA's National Marine Fisheries Service Northwest Region.

National Marine Fisheries Service. 2010. Analysis of Gravel Extraction on the Mad River. Northern California Office, Arcata, California.

National Marine Fisheries Service. 2011a. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon.

National Marine Fisheries Service. 2011b. Southern Oregon/Northern California Coast Recovery Domain 5-Year Review: Summary and Evaluation of Southern Oregon/Northern California Coast Coho Salmon ESU. NMFS Southwest Region, Long Beach, California. 58 p.

National Marine Fisheries Service. 2011c. North-Central California Coast Recovery Domain 5-Year Review: Summary and Evaluation of California Coastal Chinook Salmon ESU and Central California Coast Coho Salmon ESU. Southwest Region 54 pp.

National Marine Fisheries Service. 2011d. North-Central California Coast Recovery Domain. 5-Year Review: Summary and Evaluation of *Central California Coast Steelhead DPS Northern California Steelhead DPS*. NMFS Southwest Region, Long Beach, California. 67 p.

National Marine Fisheries Service. 2012. NOAA's National Marine Fisheries Service's final programmatic biological opinion of NOAA Restoration Center's proposed funding and the U.S. Army Corps of Engineers proposed permitting of restoration projects within the National Marine Fisheries Service's Northern California Office jurisdictional area. March 21, 2012. Arcata, California 95521.

National Marine Fisheries Service. 2013a. NOAA's National Marine Fisheries Service's final biological opinion of California Department of Transportation Routine Maintenance and Repair Activities Program in Caltrans' Districts 1, 2, and 4. October 18, 2013. Arcata, CA.

National Marine Fisheries Service. 2013b. NOAA's National Marine Fisheries Service's Endangered Species Act-Section 7 Programmatic Consultation Conference and Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for Reinitiation of Aquatic Restoration Activities in States of Oregon and Washington (ARBO II). April 25, 2015. Roseburg, OR.

National Marine Fisheries Service. 2014. Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon (*Oncorhynchus kisutch*). National Marine Fisheries Service. Arcata. CA.

National Marine Fisheries Service. 2015. Public Draft Coastal Multispecies Recovery Plan. National Marine Fisheries Service, West Coast Region, Santa Rosa, California.

Noggle, C.C. 1978. Behavioral, physiological and lethal effects of suspended sediments to juvenile salmonids. Master's thesis. University of Washington, Seattle.

Nielsen, J. L. 1998. Electrofishing California's endangered fish populations. Fisheries 23:6-12.

Nordwall, F. 1999. Movements of brown trout in a small stream: effects of electrofishing and consequences for population estimates. N. Am. J. Fish. Manage. 19:462-469.

Noss, R.F., M.A. O'Connel, and D.D. Murphy. 1997. The Science of Conservation Planning: Habitat Conservation Under the Endangered Species Act. Island Press, Washington D.C., and Covelo, California. 246 pp.

Pacific Fishery Management Council (PFMC). 1999. Preseason Report III Analysis of Council Adopted Management Measures for 1999 Ocean Salmon Fisheries. May.

Peterson, N.P. 1982. Immigration of juvenile coho salmon (Oncorhynchus kisutch) into riverine ponds. Can. J. Fish. Aquat. Sci. 39:1308-1310.

Pollock, M.M., G. Lewallen, K. Woodruff, C.E. Jordan and J.M. Castro (Editors) 2015. The Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains. Version 1.0. United States Fish and Wildlife Service, Portland, Oregon. 189 pp. Online at: http://www.fws.gov/oregonfwo/ToolsForLandowners/RiverScience/Beaver.asp

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

Powell, M.A. 1997. Water-quality concerns in restoration of stream habitat in the Umpqua basin. *In* J.D. Hall, P.A. Bisson, and R.E. Gresswell (Editors), Sea-run Cutthroat Trout: Biology, Management, and Future Conservation, pp 129-132. American Fisheries Society, Oregon Chapter, Corvallis, OR.

Quinn, T.P. 2005. The behavior and ecology of Pacific salmon and trout. UBC Press, Vancouver.

Quinn, T. P. and N. P. Peterson. 1996. The influence of habitat complexity and fish size on over-winter survival and growth of individually marked juvenile coho salmon (*Oncorhynchus kisutch*) in Big Beef Creek, Washington. Canadian Journal of Fisheries and Aquatic Sciences 53: 1555-1564.

Reeves, G.H., L.E. Benda, K.M. Burnett, P.A. Bisson, and J.R. Sedell. 1995. A disturbance-based ecosystem approach to maintaining and restoring freshwater habitats of evolutionary significant units of anadromous salmonids in the Pacific Northwest. American Fisheries Society Symposium 17:334-349.

Reeves, G.H., J.D. Hall, T.D. Roelfs, T.L. Hickman, and C.O. Baker. 1991. Rehabilitating and modifying stream habitats. Pages 519-557. In: Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. W.R. Meehan (editor). American Fisheries Society. Bethesda, Maryland.

Regonda, S.K., B. Rajagoplan, M. Clark, and J. Pitlick. 2005. Seasonal shifts in hydroclimatology over the western United States. J. Clim. 18:372-384.

Reynolds, J.B. 1983. Electrofishing. *In* L.A. Nielsen and D.L. Johnson (Editors), Fisheries Techniques, pp. 147-164. American Fisheries Society. Bethesda, MD.

Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. US Forest Service, Intermountain Research Station. General Technical Report INT-302.

Robichaud, P.R., J.W. Wagenbrenner, and R.E. Brown. 2010. Rill erosion in natural and undisturbed forests: 1. Measurements. Water Resources Research 46 (W10506).

Rogers, F.R. 2000. Assessing the effects of moderately elevated fine sediment levels on stream fish assemblages [master's thesis]. [Arcata (CA)]: Humboldt State University.

Roni, R., T.J. Beechie, R.E. Bilby, F.E. Leonetti, M.M. Pollock, and G.R. Pess. 2002. A review of stream restoration techniques and a hierarchical strategy for prioritizing restoration in Pacific Northwest watersheds. North American Journal of Fisheries Management 22:1-

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology, Inc. Pagosa Springs, Colorado.

Salmon River Restoration Council (SRRC). 2008a. Salmon River Weak Stocks Assessment. Program Report 2008. Sawyers Bar, California.

Salmon River Restoration Council (SRRC). 2008b. Salmon River spring Chinook limiting factors analysis. Draft analysis by the Salmon River Voluntary Spring Chinook Recovery Work Group.

Sandercock, F. K. 1991. Life history of coho salmon (*Oncorhynchus kisutch*). In C. Groot and L. Margolis (eds.), Pacific salmon life histories, p. 396–445. University of British Columbia Press,Vancouver, BC.

Scarlett, W. J. and C. J. Cederholm. 1984. Juvenile coho salmon fall-winter utilization of two small tributaries of the Clearwater River, Jefferson County, Washington. Pages 227–242 in J. M. Walton and D. B. Houston, editors. Proceedings of the Olympic Wild Fish Conference, 23–25 March 1983. Fish Technology Program, Peninsula College, Port Angeles, Washington.

Scheuerell, M.D., and J.G. Williams. 2005. Forecasting climate-induced changes in the survival of Snake River spring/summer Chinook salmon (*Oncorhynchus tshawytscha*). Fisheries Oceanography 14:448-457.

Sedell, J.R., G.H. Reeves, F.R. Hauer, J.A. Stanford, and C.P. Hawkins. 1990. Role of refugia in recovery from disturbances: modern fragmented and disconnected river systems. Environmental Management 14:711-724.

Servizi, J.A., and D.W. Martens. 1992. Sublethal responses of coho salmon (*Oncorhynchus kisutch*) to suspended sediments. Can. J. Fish. and Aquat. Sci. 49:1389-1395.

Shapovalov, L., and A.C. Taft. 1954. The Life Histories of the Steelhead Rainbow Trout (*Salmo gairdneri gairdneri*) and Silver Salmon (*Oncorhynchus kisutch*) with Special Reference toWaddell Creek, California, and Recommendations Regarding Their Management. California Department of Fish and Game, Fish Bulletin No. 98. 375 pp.

Sheldon, A.I. 1998. Conservation of stream fishes: patterns of diversity, rarity, and risk. Conservation Biology. 2:149-156.

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

Sicking, L. P. 2003. Anadromous fish strainers for use in wildland drafting operations. GTR-0351-1203. San Dimas, CA: U.S. Department of Agriculture, Forest Service, San Dimas Technology and Development Center.

Sigler, J.W., T.C. Bjournn, and F.H. Everest. 1984. Effects of chronic turbidity on density and growth of steelhead and coho salmon. Trans. Am. Fish. Soc. 113:142-150.

Smoker, W.W., I.A. Wang, A.J. Gharrett, and J.J. Hard. 2004. Embryo survival and smolt to adult survival in second-generation outbred coho salmon. Journal of Fish Biology 65 (Supplement A):254-262.

Solazzi, M. F., T.E. Nickelson, S.L. Johnson, and J.D. Rogers. 2000. Effects of increasing winter rearing habitat on abundance of salmonids in two coastal Oregon streams. Canadian Journal of Fisheries and Aquatic Sciences 57(5): 906-914.

Soto, T., M. Hentz, and W. Harling. 2008. Final Draft Mid-Klamath Subbasin Fisheries Resource Recovery Plan. Report to U.S. Fish and Wildlife Service, Yreka Office . November 20.

Spalding, S., Peterson, N.P., and T.P. Quinn. 1995. Summer distribution, survival and growth of juvenile coho salmon, Oncorhynchus kisutch, under varying experimental conditions of brushy instream cover. Trans. Am. Fish. Soc. 124:124.130.

Spence, B.C., G.A. Lomnicky, R.M. Hughes and R. P. Novitzki. 1996. An Ecosystem Approach to Salmonid Conservation. Funded jointly by the U.S. EPA, U.S. Fish and Wildlife Service and National Marine Fisheries Service. TR-4501-96-6057. Man Tech Environmental Research Services Corp., Corvallis, OR.

Spence, B.C., E.P. Bjorkstedt, J.C. Garza, J.J. Smith, D.G. Hankin, D. Fuller, W.E. Jones, R.Macedo, T.H. Williams, and E. Mora. 2008. A framework for assessing the viability of threatened and endangered salmon and steelhead in the North-Central California Coast recovery domain. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-423. 173 p.

Stewart, I.T., D.R. Cayan, and M.D. Dettinger. 2004. Changes toward earlier streamflow timing across western North America. J. Clim. 18:1136-1155.

Stillwater Sciences. 2010. Mad River Watershed Assessment. Prepared for the Redwood Community Action Agency. Stillwater Sciences, Arcata, CA.

Stout, H.A., P.W. Lawson, D. Bottom, T. Cooney, M. Ford, C. Jordan, R. Kope, L. Kruzic, G. Pess, G. Reeves, M. Scheuerell, T. Wainwright, R. Waples, L. Weitkamp, J. Williams, and T. Williams. 2011. Scientific conclusions of the status review for Oregon Coast coho salmon (*Oncorhynchus kisutch*). Draft revised report of the Oregon Coast Coho Salmon Biological Review Team. National Marine Fisheries Service, Northwest Fisheries Science Center. Seattle.

Strobel, B., D.R. Shively, and B.B. Roper. 2009. Salmon carcass movements in forest streams. Transactions of the American Fisheries Society 29 (3):702-714.

Swales, S., R. B. Lauzier, and C. D. Levings. 1986. Winter habitat preferences of juvenile salmonids in two interior rivers in British Columbia. Canadian Journal of Zoology 64: 1,506–1,514.

Swales, S. and C. D. Levings 1989. Role of off-channel ponds in the life cycle of coho salmon (Oncorhynchus kisutch) and other juvenile salmonids in the Coldwater River, British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 46:232-242.

Swanson, F.J. and G.W. Lienkaemper. 1978. Physical consequences of large organic debris in pacific northwest streams. USDA Forest Service, Gen. Tech. Rep., PNW-69.

Swanson, F.J., Gregory, S.V., Sedell, J.R., and A.G. Campbell. 1982. Land-water interactions: the riparian zone. In: Edmonds, R.L., ed. Analysis of coniferous forest ecosystems in the western United States. Stroudsburg, PA: Hutchinson Ross. 267-291.

Swanston, D.N. 1991. Natural processes. Pages 139-179. In: Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. W.R. Meehan (editor). American Fisheries Sociey. Bethesda, Maryland.

Switalski, T. A., J. A. Bissonette, T. H. DeLuca, C. H. Luce, and M. A. Madej. 2004. Benefits and impacts of road removal. Frontiers in Ecology and the Environment 2(1):21-28.

Thomas, V.G. 1985. Experimentally determined impacts of a small, suction gold dredge on a Montana stream. N. Am. J. Fish. Manage. 5:480-488.

Tonina, D. and J.M. Buffington. 2009. Hyporheic exchange in mountain rivers: mechanics and environmental effects. Geography Compass 3/3:1063-1086.

Tschaplinski, P.J. 1988. The use of estuaries as rearing habitats by juvenile coho salmon. In T.W. Chamberlain (ed.), Proceedings of a workshop: Applying 15 years of Carnation Creek results. (pp. 123-142). Nanaimo, BC: British Columbia Ministry of Environment, Lands, and Parks.

Tschaplinski, P. J., and G. F. Hartman. 1983. Winter distribution of juvenile coho salmon (*Oncorhynchus kisutch*) before and after logging in Carnation Creek, British Columbia, and some implications for overwinter survival. Canadian Journal of Fisheries and Aquatic Sciences 40: 452–461.

USDA Forest Service. 1995a. Six Rivers National Forest Land and Resource Management Plan. Eureka. CA.

USDA Forest Service. 1995b. Klamath National Forest Land and Resource Management Plan. Yreka. CA.

USDA Forest Service 2005. Forest Service Manual 2600, Chapter 2670-Threatened, Endangered and Sensitive Plants and Animals. USDA Forest Service. Washington, DC.

USDA Forest Service. 2011a. Watershed Condition Framework. FS-977. Washington DC. 24pp.

USDA Forest Service. 2011b. Forest Service Handbook 2509.22, Chapter 10-Water Quality Management Handbook. USDA Forest Service. Vallejo, CA.

USDA Forest Service. 2014. The Smith River National Recreation Area Restoration and Motorized Travel Management DEIS. R5-MB-272. 617 pages.

USDA Forest Service, USDC National Marine Fisheries Service, USDI U.S. Fish and Wildlife Service and Bureau of Land Management (USDA-USDC-USDI). 2004. Analytical Process for Developing Biological Assessments for Federal Actions Affecting Fish Within the Northwest Forest Plan Area.

USDA Forest Service-Six Rivers National Forest. 2015. Watershed and Fisheries Restoration Program 2015-2030 Biological Assessment: Threatened, Endangered, Proposed Anadromous Species and Forest Service Sensitive Anadromous Salmonids. Six Rivers National Forest: Klamath National Forest-Ukonom District. Eureka, CA..

USDA and USDI. 1994. Final supplemental environmental impact statement on management of habitat for late successional and old-growth forest related species within the range of the northern spotted owl (Northwest Forest Plan). U.S. Department of Agriculture and U.S. Department of Interior. February.

United States Environmental Protection Agency (USEPA). 2007. Mad River Total Maximum Daily Loads for Sediment and Turbidity. United States Environmental Protection Agency Region IX

U.S. Forest Service (USFS). 2000. New River watershed analysis. Shasta-Trinity National Forest. May

U.S. Forest Service (USFS). 2001. 2000-01 Chinook and Coho Spawning Report. Six Rivers National Forest, Lower Trinity Ranger District.

U.S. Forest Service (USFS). 2009a. Unpublished data of juvenile coho in tributaries to the Middle Klamath between 2002 and 2009. Provided by Jon Grunbaum, Biologist, Klamath National Forest, Happy Camp, California

U.S. Forest Service (USFS). 2009b. Klamath National Forest (KNF) Comments received on CoManager Draft SONCC Coho Salmon Recovery Plan from Klamath National Forest staff.

USFWS. 2010. Best management practices to minimize adverse effects to Pacific lamprey (*Entosphenus tridentatus*). U.S. Fish and Wildlife Service, Pacific Region, Fisheries Resources. Portland, Oregon.

Van Kirk, R. W., and S. W. Naman. 2008. Relative effects of climate and water use on base-flow trends in the lower Klamath basin. Journal of American Water Resources Association 44(4): 1035-1052.

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

Vicuna, S., E. P. Maurer, B. Joyce, J. A. Dracup, and D. Purkey. 2007. The sensitivity of California water resources to climate change scenarios. J. Am. Water Resour. Assoc. 43:482-498.

Waters, T.F. 1995. Sediment in streams: sources, biological effects and control. American Fisheries Society, Bethesda, MD.

Wemple, B.C., J.A. Jones, and G.E. Grant. 1996. Channel network extension by logging roads in two basins, western cascades, Oregon. Water Resources Bulletin 32(6):1195-1207.

Williams, T.H., E.P. Bjorkstedt, W.G. Duffy, D. Hillemeier, G. Kautsky, T.E. Lisle, M. McCain, M. Rode, R.G. Szerlong, R.S. Schick, M.N. Goslin, and A. Agrawal. 2006. Historical population structure of coho salmon in the Southern Oregon/Northern California coasts evolutionarily significant unit. U.S. Department of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-390, 71 p.

Williams, T. H., S. T. Lindley, B.C. Spence, and D.A. Boughton. 2011. Status Update for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Southwest. 17 May 2011 – Update to 5 January 2011 report. National Marine Fisheries Service. Southwest Fisheries Science Center. Santa Cruz, CA.

Williams, T.H., B.C. Spence, W. Duffy, D. Hillemeier, G. Kautsky, T.E. Lisle, M. McCain, T.E. Nickelson, E. Mora, and T. Pearson. 2008. Framework for assessing viability of threatened coho salmon in the Southern Oregon/Northern California coast evolutionarily significant unit. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-432. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Southwest Fisheries Science Center. La Jolla, California. 96 p. http://swfsc.noaa.gov/publications/TM/SWFSC/NOAA-TM-NMFS-SWFSC-432.pdf.

Wipfli, M.S., J.P. Hudson, D.T. Chaloner, and J.P. Couette. 1999. Influence of salmon spawner densities on stream productivity in southeast Alaska. Canadian Journal of Fisheries and Aquatic Sciences 56:1600–1611.

Yoshiyama, R.M. and P.B. Moyle. 2010. Historical review of Eel River anadromous salmonids, with emphasis on Chinook salmon, coho salmon and steelhead. University of California at Davis. Center for Watershed Sciences working paper; a report commissioned by California Trout. Davis, CA. February 1.

Yurok Tribe. 2001. Letter to Irma Lagomarsino, NMFS, from Troy Fletcher regarding preliminary Yurok Tribe comments on draft biological opinion on ongoing Klamath Project operations. March 23.

Zhu, T., M.W. Jenkins, and J.R. Lund. 2005. Estimated impacts of climate warming on California water availability under twelve future climate scenarios. J. Am. Water Res. Assoc. 41:1027-1038.