**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
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MAY 17 2012

MEMORANDUM FOR: Fruit Growers Supply Company HCP Project File (#151422SWR2008AR00330)

FROM: for Rodney R. McInnis
Regional Administrator, Southwest Region

SUBJECT: Biological and Conference Opinion for the Fruit Growers Supply Company Multi-Species Habitat Conservation Plan

The attached Biological and Conference Opinion (Opinion) and Essential Fish Habitat (EFH) Consultation represent NOAA's National Marine Fisheries Service (NMFS) Southwest Region, Endangered Species Act section 7(a)(2) biological opinion on the Proposed Issuance of an Incidental Take Permit to Fruit Growers Supply Company (FGS) for Implementation of the Fruit Growers Supply Company Multi-Species Habitat Conservation Plan (HCP) dated March, 2012. The Opinion also includes a report addressing Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Conservation Recommendations for the permit area.

Issuance of an incidental take permit (ITP) to FGS to authorize take of covered species for FGS's Covered Activities required an assessment by NMFS of the HCP's effects on covered species. NMFS has concluded that implementation of the HCP will avoid, minimize, and mitigate for Covered Activity adverse effects on covered species to the maximum extent practicable. The covered species addressed in this Opinion are the Southern Oregon/Northern California Coast (SONCC) coho salmon Evolutionarily Significant Unit (ESU) (and its designated critical habitat), Upper Klamath and Trinity Rivers Chinook salmon ESU, and Klamath Mountains Province (KMP) steelhead ESU. The Upper Klamath and Trinity Rivers Chinook salmon ESU, and KMP steelhead ESU are currently not listed under the federal Endangered Species Act (ESA) of 1973, as amended, however FGS chose to include them in the HCP's aquatic conservation strategy should they become listed during the proposed ITP term (50 years).

NMFS has concluded that the proposed issuance of an ITP to FGS and implementation of the HCP is not likely to jeopardize the continued existence of the SONCC coho salmon ESU, nor is it likely to result in the destruction or adverse modification of its designated critical habitat. NMFS also concluded that the proposed issuance of an ITP is not likely to jeopardize the continued existence of Upper Klamath and Trinity Rivers Chinook salmon ESU, or KMP steelhead ESU. Since both of these species are not currently listed, critical habitat has not been designated for either species.

Finally, NMFS concludes that the issuance of an ITP to FGS and implementation of the HCP will result in a level of continued adverse effects on Salmon EFH within the action area during the permit term. However, implementation of the HCP and associated conservation measures will mitigate and minimize adverse effects resulting in improved EFH habitat as compared to baseline conditions. Therefore, NMFS concludes that no additional Conservation Recommendations are needed.

Attachment

# BIOLOGICAL AND CONFERENCE OPINION

## Issuance of Incidental Take Permit
## for the Implementation of the
## Fruit Growers Supply Company
## Multi-Species Habitat Conservation Plan

National Marine Fisheries Services
Southwest Region

File No.  151422SWR2008AR00330

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# 1 BACKGROUND AND CONSULTATION HISTORY

## 1.1 Background

The Fruit Growers Supply Company (FGS) first approached the NOAA's National Marine Fisheries Service (NMFS) in approximately 2001, expressing an interest in cooperatively working on the development of a Habitat Conservation Plan (HCP) for sensitive aquatic species that may be affected by their timber harvesting operations in Siskiyou County, California. NMFS has worked extensively with industrial timberland owners in northern California for more than a decade under the Section 10(a)(1)(B) program of the federal Endangered Species Act of 1973 (ESA), as amended, which allows for the taking of federally listed species incidental to otherwise lawful activities (in this instance, timber harvest and management). A non-federal entity may submit an application to NMFS for an incidental take permit (ITP), and part of the application must include the submittal of an HCP prepared by the applicant. A non-federal applicant may elect to include non-listed species in their HCP to increase the biological value of the HCP and to provide assurances to the applicant in the event the species are listed under the federal ESA in the future. FGS is requesting NMFS to authorize the incidental take of threatened Southern Oregon/Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*) Evolutionarily Significant Unit (ESU), and asked that NMFS include two non-listed species, Upper Klamath and Trinity Rivers Chinook salmon (*O. tshawytcha*) ESU, and Klamath Mountains Province (KMP) steelhead (*O. mykiss*) ESU on the permit with an effective date for authorization to incidentally take the two species at the time of listing, should NMFS determine listing of these species is necessary during the 50-year permit term of the FGS ITP. When requested by an applicant to include non-listed species, NMFS treats all unlisted species in an HCP in the same manner as species that are proposed for listing with respect to conferencing procedures (50 CFR § 402.10). Concurrent with this request to NMFS, FGS is also seeking an incidental take permit from the U.S. Fish and Wildlife Service (USFWS) for the incidental take of federally threatened northern spotted owl (*Strix occidentalis caurina*). The HCP also includes a conservation strategy for the federally endangered plant, Yreka phlox (*Phlox hirsuta*).

Section 7(a)(2) of the ESA, as amended (ESA; 16 U.S.C. 1539(a)(2)) requires each federal agency to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency's action "may affect" a listed species, that agency is required to consult with NMFS or the USFWS (together the Services), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR 402.14(a)).

Consistent with agency policy and practice, NMFS initiated an intra-service consultation on our consideration of issuing an ITP to FGS pursuant to Section 10(a)(1)(B) of the ESA. This document represents NMFS' consultation process and our biological and conference opinion (Opinion) on the effects of the proposed action on threatened SONCC coho salmon, and unlisted Klamath and Trinity Rivers Chinook salmon and KMP steelhead (collectively referred to as covered species). The purpose of this Opinion is to determine, based upon the best scientific and commercial data available, whether NMFS' issuance of the ITP and the implementation of activities covered under the ITP, are likely to jeopardize the continued existence of covered species or adversely modify or destroy designated critical habitat. The conference aspects of this

Opinion apply to the Klamath and Trinity Rivers Chinook salmon and KMP steelhead. In this document, we analyze the effects of the proposed action on these two unlisted species as if they were proposed for listing to determine whether implementation of the HCP is likely to jeopardize the continued existence of these species. Because Klamath and Trinity Rivers Chinook salmon and KMP steelhead are currently unlisted species, NMFS has not designated critical habitat for these species. Should either of these species become listed under the ESA in the future, NMFS will issue a permit to FGS authorizing take of the species listed as long as FGS is in compliance with terms of their existing permit and HCP.

This Opinion is based upon, among other things, our review of the Final Fruit Growers Supply Company Multi-Species Habitat Conservation Plan, dated March 2012, and the final administrative Final Environmental Impact Statement (FEIS) for Authorization for Incidental Take and Implementation of Fruit Growers Supply Company Multi-Species Habitat Conservation Plan, previous review drafts, the HCP and EIS materials provided by FGS in the course of developing conservation strategies for covered species, status reviews, listing documents, preliminary recovery plan information for SONCC coho salmon, past and current research and population dynamics modeling efforts for SONCC coho salmon, and published and unpublished scientific information on the biology and ecology of covered species, their habitat requirements, and published information on the impacts of forest management on Pacific salmonids. This Opinion has been prepared in accordance with Section 7 of the ESA and its implementing regulations.

### 1.2 Consultation History

As noted, discussions between FGS and NMFS on the development of an HCP go back a number of years. In the early part of the discussions surrounding a conservation plan for salmonids, multiple meetings and teleconference calls were held with FGS and NMFS on important topic areas such as level of impacts anticipated from a 50-year timber management plan, biological goals and objectives for the HCP, data needs, monitoring strategies, and what would constitute changed and unforeseen circumstances. During this same time, FGS engaged in similar consultations with the USFWS in regards to the conservation strategy for northern spotted owl and Yreka phlox. At times, during the many years of development of the HCP strategies, other workload priorities for NMFS and USFWS required reallocation of time commitments from agency staff towards the FGS HCP leading the technical and policy discussions of the HCP to extend for several years. This timeframe for developing a large timber-related HCP, covering numerous species located on more than 150,000 acres of land, is fairly typical in the Pacific Northwest. For the past three years, USFWS and NMFS (together, the Services) have worked diligently with FGS and a contractor, CH2MHill, and the California Department of Fish and Game (CDFG) in developing the framework for the HCP and the concurrent Environmental Impact Statement (EIS) developed for analyzing alternatives to the proposed action. These increased coordination meetings have occurred since January 2008 via weekly teleconference calls, face-to-face meetings, and e-mail exchanges, and included periodic reviews of draft chapters of the HCP and draft EIS.

On March 18 and 19, 2008, the Services held public scoping meetings in Yreka and Happy Camp, California, asking for input from interested members of the public, including regional tribes, on suggestions and information from other agencies and the public on the scope of issues and alternatives that should be addressed in the development of a draft EIS. The primary purpose of the scoping process was to identify important issues raised by the public related to the issuance of ITPs for the HCP. These scoping meetings were announced in local newspapers and the *Federal Register* on February 22, 2008 (73 FR 9776). Staff from the Services, CH2MHill, and FGS attended the scoping meetings to discuss the preliminary HCP strategy and answer questions on the process necessary to make a determination of whether to issue ITPs from each agency.

In November 2009, the Services released the Draft HCP and Draft EIS for public review and comment (74 FR 58602). The Draft HCP and Draft EIS were mailed to interested stakeholders and made available for review at five public libraries located within the northern California region where the HCP was planned to occur. A public meeting outlining the proposed HCP and alternatives developed for the Draft EIS was held on December 2, 2009, in Yreka, California. Public comments were taken at this meeting and the Services invited written public comments for a period of 90 days, with the public comment period closing on February 11, 2010. The Services received hundreds of individual "e-mail postcard" type comments from two environmental organizations, several individual comments in support of the HCP, and detailed comments opposing the HCP from several environmental organizations.

The Services officially initiated formal consultation on the proposed action, issuance of ITPs, upon the completion of the final Administrative Review Draft of the EIS. Consultation began at this time as it was determined by NMFS that the proposed project, the HCP, was complete once the Services finalized their assessment of public comments received on the Draft EIS and HCP, resulting in changes to both documents. Final modification of the documents constituted the final proposed action, and this occurred around January, 2011. Consultation officially concluded when a Final HCP (dated March 2012) was submitted to NMFS.

## 2 DESCRIPTION OF THE PROPOSED ACTION

The action considered in this Opinion is NMFS' issuance of a permit authorizing the incidental take of threatened SONCC coho salmon associated with FGS's operations on its Hilt properties and conducted as proposed under the HCP. FGS owns approximately 335,000 acres of timberland in California, Oregon, and Washington; its Hilt properties are located in northern California within Siskiyou County (see Fig. 1). NMFS also proposes to include two currently unlisted species of salmonids (Klamath and Trinity Rivers Chinook salmon, and KMP steelhead), which as noted previously, are treated in this Opinion as if they are proposed for listing. The term of the ITP and thus implementation period of the HCP is 50 years.

The action agency in this consultation is NMFS, as NMFS proposes to issue an ITP to the applicant, FGS. NMFS received an ESA Section 10(a)(1)(B) ITP application from FGS in September 2009, which NMFS processed as a complete application at that time and further processed as described above. For the purposes of formal intra-agency consultation, FGS is the applicant for a permit, which NMFS is proposing to issue (the federal action).

FGS's activities covered by the proposed ITP (covered activities), and described in the HCP include timber operations and related management activities on the FGS ownership in the areas described below and depicted in Figure 1, and the activities needed to carry out all measures identified in the HCP. Timber operations and related management activities include, but are not limited to felling and bucking timber, yarding timber, loading and other landing operations, salvaging timber products, transporting timber and rock products, road construction and maintenance, rock pit construction and use, water drafting for dust abatement and fire suppression, equipment maintenance, regeneration harvest, site preparation, prescribed burning, slash treatment, planting, pre-commercial thinning and pruning, commercial thinning, and the collection and transport of minor forest products such as burls, stumps, boughs, and Christmas trees. FGS does use herbicides in their forest management practices and may on occasion use insecticides to control pest outbreaks; however, as these substances are regulated by the U.S. Environmental Protection Agency (EPA), including their appropriate use near waterbodies, herbicide and insecticide application will not be a FGS covered activity, but will be considered in the *Interrelated and Interdependent Actions* section of this Opinion.

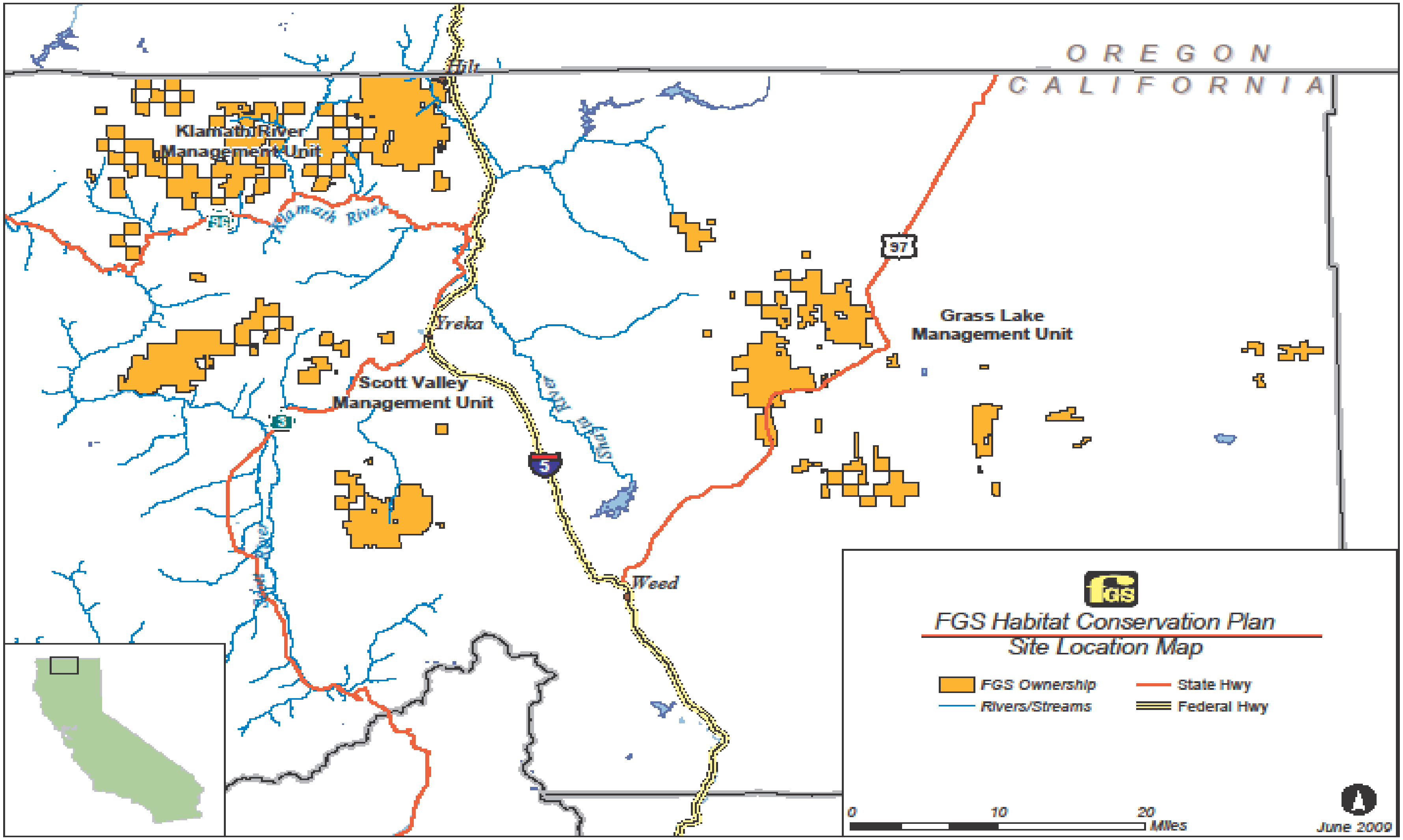


Figure 1. Proposed Fruit Grower's Supply Company Habitat Conservation Plan Area (land in orange), Siskiyou County, California (From FGS 2009).

## 2.1 Covered Activities

### 2.1.1 Timber Harvest

Timber harvest includes activities necessary to the logging and transport of timber products: felling and bucking of timber, yarding timber, salvage of timber products, and transport of timber products.

Felling and Bucking of Timber: Timber felling is the first step in any logging operation and includes cutting trees (felling) and "bucking" (cutting the felled tree in predetermined log lengths). Felling and bucking are generally done with chain saws by crews that work in pairs. On gentle terrain, mechanical felling machines (feller-bunchers) can be used to fell the trees and place them in a pile for skidding to the log landing.

### 2.1.2 Yarding Timber

Yarding, also known as "skidding," is the movement of logs from where they are felled or piled to the log landing. Generally, tractor-based systems are used on relatively gentle terrain, cable yarders are used on steeper slopes, and helicopters are used in areas where access is otherwise prohibitive.

*Ground-based Yarding*

Ground-based yarding usually involves the use of tracked or rubber-tired tractors (skidders) to move logs to the landing. The skidders are usually equipped with mechanical grapple attachments or wind lines to grasp the logs, and they follow constructed "skid trails" on all but the mildest terrain. Generally, logs are skidded in a downhill direction, and occasionally logs are skidded uphill across short distances. Operators can use a shovel or a hydraulic boom log loader to move logs a short distance. A shovel is a tracked excavator that is fitted with a grapple for grasping logs. The shovel may move a short distance off the truck road to pick up felled logs and pass them back to the truck road using the "swing" function of the boom structure. Construction of skid trails is not necessary when using a boom loader as the loaders are able to operate on surface slash (bucked tree limbs) within gentle terrain. Typically, operators conduct ground-based yarding on slopes less than 55 percent.

*Cable Yarding*

Cable yarding generally involves the use of steel cables to skid logs to a truck road or log landing using a yarder that is set up on the haul road or landing. A yarder has a vertical tower held in place by a number of guylines. The skidding cables are on a number of powered drums used to haul or skid the logs to the landing. The tower is used to elevate and lift the cables, hence providing lift to logs as they are yarded to the landing. High-lead systems lift only the lead end of logs so that the logs do not dig into the soil surface as they are yarded, and are typically utilized for short reaches. Skyline systems involve the use of a skyline cable that runs from the top of the tower to an anchor located at some elevated point beyond the harvest area. Logs attach to a carriage that rides on the skyline cable, providing increased lift to suspend logs above the ground surface. Generally, logs are yarded uphill with cable systems, but occasionally these systems are used for downhill yarding. Typically, cable yarding is the preferred method on slopes greater than 55 percent.

*Aerial Yarding*

Aerial yarding by helicopter is used where roads cannot be constructed to provide access to a harvest unit for conventional (ground-based or cable) yarding systems. Aerial logging suspends logs from long cables and transports them to the landing with virtually no ground disturbance. In general, it is not necessary for the helicopter to land in the loading area. However, a separate service landing provides a clean, rocked, debris- and dust-free area to protect the helicopter's engine(s) from damage. This yarding technique is usually reserved for steep (>65 percent) and/or unstable terrain, although lack of a road right-of-way may trigger its use. As this method of yarding is the most costly, it is not extensively used in forested landscapes in northern California.

### 2.1.3 Loading and Landing Operations

After yarding logs to a landing or roadside, there may be additional saw work to remove limbs, buck long pieces into shorter segments, or to remove broken sections. These operations are conducted by hand (chain saws) or using a mechanical delimber. Logs are then loaded onto log trucks using a shovel or front-end loader (a wheeled bucket loader equipped with log forks instead of a bucket). Some log-trucks have their own loading system (self-loaders).

### 2.1.4 Salvage of Timber Products

Dead, dying, and downed trees are salvaged periodically. Salvage relates to road maintenance, fire damage, insect damage, or storm damage. Removal of dead and dying trees occurs if they can be easily salvaged and yarded onto an adjacent road during harvest activities on adjacent units. Salvage operations typically occur in isolated locations throughout the proposed HCP area and consist of harvesting dead and dying conifers as individuals or in small groups. Salvage operations can prevent incidences of wildfire as dead and dying trees are more susceptible to ignition and quick burn.

### 2.1.5 Transport of Timber Products

Transport of timber products occurs along roads via truck and trailer. Maintenance activities on these haul roads is described below.

### 2.1.6 Road Construction and Maintenance

With regard to road use, the proposed HCP and ITP would cover general road use, construction, and maintenance activities carried out on roads owned by and under control of FGS. Construction and maintenance activities pursuant to cooperative road use and maintenance agreements between FGS and the U.S. Forest Service (USFS) are not covered activities under this HCP. The USFS has an independent obligation to consult with the Services on the effects of their roads and other management activities on listed species on USFS lands, including those they share with FGS. Covered activities for the maintenance, improvement, construction, and closure of roads and landings on FGS Covered Lands include the following:

- Construction of new roads in connection with timber management, including clearing vegetation from road rights-of-way, removing trees, grubbing (removing stumps and surface organics), grading, and compaction
- Drainage facility repair and/or upgrade, and erosion control
- Construction of stream crossings (bridges, culverts, fords, and a variety of temporary crossings), includes road upgrading
- Maintenance or reconstruction of surfaced roads, seasonal roads, culverts, bridges, fords, cuts, and fillslopes
- Closure of roads; temporarily (abandoned) or permanently (decommissioned)
- Dust abatement activities including treating road surfaces with materials commonly used for dust abatement, including but not limited to lignin, calcium chloride, magnesium chloride, or water
- Construction and maintenance of water holes used for water drafting
- Water drafting for dust abatement, road construction, and routine maintenance

### 2.1.7 Extraction of rock, sand, and gravel from small borrow pits

Covered activities also include rock quarrying. FGS quarries rock from a number of locations within the covered lands area for obtaining material for road surfacing. FGS has four primary rock quarries on the ownership that are each less than two (2) acres in size. These quarries supply FGS with rock for road construction and other maintenance activities on roads governed by cooperative agreements with the USFS. Within the proposed HCP Plan Area, typically up to five or more local rock sources, commonly referred to as “borrow pits,” are developed as needed for road upgrades associated with timber harvest plans (THPs). Each local rock source is rarely larger than 0.5 acres in size and is most often located in the upper portions of watersheds away from fish-bearing watercourses.

### 2.1.8 Silviculture

Silviculture is the manipulation of forest vegetation to accomplish a specified set of objectives. It controls forest establishment, composition, and growth. FGS designs their silvicultural practices to maintain and enhance the productivity of its timberlands by promoting prompt regeneration of harvested areas and higher rates of forest growth. Silvicultural treatments vary by stand age, stand condition, site class, and species composition.

The types of silvicultural methods commonly employed by FGS throughout their ownership and their application in the development of the Sustained Yield Plans are consistent with the methods defined and regulated in the California Forest Practice Rules (CFPRs).

FGS’s forest inventory serves as the foundation for long-term planning by identifying stands of generally homogeneous sites, stocking (number, area, and volume of trees per acre), and predicted best silvicultural strategies. Through their "Maximum Sustainable Production" (MSP) analysis, FGS estimates the periodic forest conditions at the landscape level. For planning purposes stands of similar conditions are combined and a range of feasible silvicultural is modeled for each of these (e.g., clearcut) units with yields reported at the mid-point of each decade. Once a given silviculture is applied it limits the range of future silvicultural opportunities for a given stand. The current MSP analysis is intentionally non-spatial so that silviculture can be developed at the landscape level and applied at the stand level on the basis of need. Each stand is part of a modeling unit in which a range of silvicultural practices are designated by acres by decade. The forester applies silviculture within these limits and within other spatial constraints such as for areas protected for other resources.

*Forest Management Regimes*

"Even-aged" forest management generally means managing trees by methods that will achieve closely aged tree stands over time. Generally, this is accomplished by "clear-cutting" which is the cutting of all trees in a stand. "Uneven-aged" forest management is used to harvest trees individually or in small groups with the goal of developing or maintaining a variety of age classes within a stand. Typically, sites are restocked through natural regeneration and, where necessary, supplemented by planting seedlings obtained from a nursery to meet CFPR stocking standards.

The general categories of silviculture utilized by FGS include even-aged regeneration, even-aged thinning, and uneven-aged treatments. Even-aged regeneration (EAR) produces stands that will remain in young seral stages for 20 to 50 years depending on site potential (the growth properties of an area) and stocking retained. These units are generally small, from 10 to 30 acres, and scattered on the landscape. In most cases, EAR targets marginally stocked and/or deteriorating stands to improve their long-term productivity. Silvicultural methods include clearcutting, seed tree, and shelterwood. Regeneration of the commercially valuable trees occurs artificially through planting nursery-grown seedlings, or naturally by seed trees (trees left in the stand that will produce offspring) retained within harvest units. FGS retains the seed trees to propagate certain species or characteristics [for example, rust (fungal) resistance]. Even-aged thinning (EAT) units are intermediate treatments of mid-seral even-aged stands designed to accelerate growth of non-harvested trees. Typically, after an even-aged stand area has been planted and allowed to grow for 10-15 years, foresters will remove selected trees thought to have the least potential for robust growth and survivability, "thinning out" the stand to allow the remaining desirable trees more space and nutrients to continue their growth. Generally, FGS designs uneven-aged (UEA) harvests to maintain an inverse J-shaped distribution of tree sizes at a stocking level that maximizes board foot growth at the stand level.

The amount of even-aged silviculture relative to uneven-aged silviculture in the HCP area is identified in the FGS Sustained Yield Plan (SYP) which will be modified to incorporate HCP restrictions should ITP's be issued. The SYP will detail the estimated amount of each type of silviculture (acres) applied each decade over the term of the ITPs. FGS' projected periodic maximum harvest by watershed by decade is presented in Table 1.

*Silvicultural Methods*

*Clearcutting*

The clearcutting regeneration method involves the removal of a stand in one harvest. Regeneration after harvesting is obtained by direct seeding, planting, sprouting, or by natural seed fall. When practical, clearcuts are irregularly shaped and variable in size in order to mimic natural patterns and features found in landscapes. Even-aged regeneration harvests have been allocated to portions of most merchantable-sized timber types on the Hilt/Siskiyou Forest. Actual clearcut unit locations shall be determined during THP layout by the area foresters.

*Commercial Thin*

Commercial thinning is the removal of trees in a young-growth stand to maintain or increase average stand diameter of the residual crop trees, promote timber growth, and/or improve forest health. FGS uses commercial thinning as a tool to extend the "life" of some stands before using a regeneration harvest to balance the distribution of age-classes across the forest. Used in this manner, commercial thinning can improve stand health and growth in relatively healthy, well-stocked, saw log-sized (trees big enough to mill) stands that exceed target-stocking requirements.

*Biomass Thin*

FGS uses biomass thinning as an intermediate treatment (after commercial thin but before full harvest) to thin younger, overstocked, submerchantable-sized stands to improve stand health and growth. It is predominantly used in young ponderosa pine stands and in mixed conifer stands with a heavy pine component. Stands are thinned from below. Although some saw logs are harvested, the main product is hog fuel for use in electric or steam co-generation plants or paper chips from trees ranging from 4 to 10 inches diameter breast height (dbh). It is also a valuable tool to reduce wildfire potential.

*Seedtree/Shelterwood Removal (Even-aged)*

Where a two-tiered structure of a healthy, well-stocked understory with a scattered overstory exists, FGS may remove even-aged seed trees and shelterwood. Future harvests will be even-aged (one or two commercial thins followed by regeneration harvests). The benefits of using this method are improved stand health, release of understory regeneration, and promoting a more regular structure. This silvicultural method is widely used in all of the management units on FGS' ownership.

**Table 1. FGS Projected Periodic Maximum Harvest (percentage of total drainage area) on Covered Lands (from FGS 2012)**

| Drainage Name | Drainage Area (acres) | Percentage of Drainage Area Harvested by Permit Decade | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| **Class A* Designated Lands** | | | | | | |
| Beaver | 69,650 | 10.62 | 3.76 | 7.81 | 11.66 | 11.64 |
| Big Ferry | 6,270 | 14.46 | 2.76 | 2.41 | 3.22 | 12.58 |
| Canyon | 12,919 | 12.06 | 0.92 | 2.22 | 0.92 | 11.27 |
| Cottonwood | 63,540 | 14.06 | 7.25 | 3.80 | 7.32 | 10.21 |
| Doggett | 7,693 | 9.91 | 11.21 | 17.60 | 22.09 | 31.42 |
| Dona | 8,440 | 3.84 | 9.00 | 8.18 | 16.59 | 19.95 |
| Dutch Creek | 6,457 | 19.16 | 1.75 | 17.37 | 15.88 | 24.59 |
| Empire Creek | 6,038 | 32.48 | 3.39 | 2.09 | 19.00 | 16.80 |
| Horse | 38,969 | 4.08 | 7.93 | 11.60 | 14.26 | 16.69 |
| Indian | 13,851 | 13.49 | 3.66 | 6.54 | 12.61 | 18.72 |

| Drainage Name | Drainage Area (acres) | Percentage of Drainage Area Harvested by Permit Decade | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Lumgrey Creek | 5,475 | 28.30 | 0.25 | 6.52 | 22.06 | 21.24 |
| Meamber | 8,197 | 47.35 | 4.83 | 9.81 | 29.13 | 22.42 |
| Middle Klamath | 153,397 | 0.33 | 0.00 | 0.08 | 0.12 | 0.45 |
| Mill | 14,291 | 2.52 | 0.00 | 1.04 | 4.18 | 6.69 |
| Moffett | 93,843 | 3.02 | 3.25 | 6.13 | 2.33 | 9.21 |
| Pat Ford | 7,637 | 17.34 | 0.72 | 7.19 | 7.99 | 13.68 |
| Patterson | 4,027 | 49.27 | 1.34 | 14.86 | 16.58 | 20.38 |
| Rattlesnake | 11,444 | 7.28 | 1.79 | 0.21 | 5.10 | 6.22 |
| Seiad | 33,783 | 0.00 | 0.60 | 1.48 | 2.36 | 3.21 |
| **Class B* Designated Lands** | | | | | | |
| Bogus Creek | 34,557 | 1.11 | 2.28 | 1.84 | 0.12 | 3.07 |
| Duzel | 6,548 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| EF Scott | 72,846 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| McConaughy | 23,974 | 0.00 | 0.06 | 0.11 | 0.00 | 0.09 |
| Willow Creek | 25,025 | 0.42 | 0.24 | 0.89 | 1.58 | 2.31 |
| **Class C* Designated Lands** | | | | | | |
| Antelope Creek | 19,215 | 0.76 | 0.60 | 0.28 | 0.44 | 1.25 |
| Antelope Sink | 28,314 | 0.78 | 1.19 | 0.96 | 1.39 | 1.74 |
| Elliott Creek | 21,305 | 10.37 | 8.01 | 6.08 | 14.87 | 10.60 |
| Fourmile Hill | 43,952 | 0.21 | 0.30 | 0.07 | 0.27 | 1.19 |
| Garner Mtn | 19,160 | 0.00 | 0.76 | 5.67 | 0.06 | 5.84 |
| Glass Mtn | 47,984 | 0.00 | 0.00 | 2.32 | 0.39 | 3.86 |
| Grass Lake | 55,095 | 2.34 | 3.59 | 9.00 | 6.84 | 11.55 |
| Headwaters | 21,043 | 4.08 | 6.75 | 9.76 | 7.84 | 12.01 |
| Horsethief | 58,536 | 0.14 | 0.49 | 3.16 | 2.75 | 5.57 |
| Juanita Lake | 28,102 | 0.14 | 0.60 | 1.73 | 2.10 | 2.79 |
| Little Shasta | 39,337 | 2.73 | 2.49 | 8.61 | 5.77 | 11.09 |
| NW Mt Shasta | 100,266 | 0.01 | 0.37 | 0.84 | 0.68 | 0.63 |
| Shasta Valley | 278,087 | 0.01 | 0.02 | 0.20 | 0.01 | 0.25 |
| Shasta Woods | 36,472 | 1.57 | 1.41 | 8.02 | 2.73 | 8.20 |

* Class A, B, and C land designations are part of the HCP Aquatic Conservation Plan Strategy(see Section 2.4.2 of this Opinion for more detail)

Under the Proposed Action the amount of early and mid-seral forest with high canopy coverage conditions would decrease initially by up to 20 percent in mostly the Class A and B drainages as FGS enters northern spotted owl stands currently off-limits by the CFPRs. By the end of the permit term, acreage of mid to late seral conifer stands in Class A and B lands is expected to more than double current conditions as habitat within spotted owl Conservation Support Areas (CSAs) is allowed to develop and riparian stands protected under HCP restrictions also develop.

*Selection/Group Selection (Uneven-aged)*
This silvicultural method is used in heavily stocked, relatively healthy stands that have an uneven-aged structure. Merchantable trees are harvested from all size classes present. The intent is to maintain an uneven-aged structure, maintain stand health, and generate a harvest return. Harvest entries occur every 10 to 20 years. Selection harvest is also applied to other stands throughout FGS ownership on the Hilt/Siskiyou forest, including those in watercourse protection zones and on potentially unstable slopes, including inner gorges and shallow, unstable soils.

*Alternative Prescriptions*
FGS commonly uses a number of alternative prescriptions in its silvicultural management. The analysis and approval of alternative prescriptions occurs during the THP review process. In most cases where FGS has used alternative prescriptions, these past management and timber harvests have created an irregular condition in stand structure and/or stocking. Standard silvicultural prescriptions as specified in the rules are difficult to apply in these irregular stands. The FGS management scheme is to maintain stand health and generate a periodic and economical harvest in these stands using alternative prescriptions over the first 1 to 4 years, gradually building up inventory to a point where FGS can apply standard silvicultural prescriptions. These alternative prescriptions include, but are not limited to, the following:

- Seedtree/shelterwood removal (uneven-aged)
- Modified selection
- Combination shelterwood removal/biomass thin
- Modified commercial thin
- Combination shelterwood removal/commercial thin

### 2.1.9 Stand Regeneration and Improvement

Timber stand regeneration and improvement includes activities necessary to establish, grow, and achieve the desired species composition, spacing, and rate of growth of forest stands on the ownership:

- Site preparation, prescribed burning, and slash treatment
- Tree planting
- Vegetation management
- Silvicultural thinning (includes biomass, pre-commercial, and commercial thinning). Biomass and commercial thinning are described previously under silvicultural methods.

<u>*Site Preparation*</u>
Site preparation activities for even-aged regeneration involves the removal of logging residue and/or unwanted shrub and tree species. This is typically accomplished by tractor piling and burning, broadcast burning, or, less commonly, by mechanical methods. By removing fuels, this treatment has the additional benefit of reducing the potential for wildfire to ignite or spread. As needed, fuel breaks are constructed in order to protect timberlands. Area foresters determine the need and location of fuel breaks in consultation with the California Department of Forestry and Fire Protection (CALFIRE) as necessary. Occasionally, site preparation also requires soil

scarification for planting. This treatment applies only to regeneration harvest units where it may be necessary to ensure successful regeneration.

*Tree Planting*
Artificial regeneration is commonly used to ensure that sites are adequately stocked as per stocking requirements. The usual practice is to plant seedlings in those areas that have been either clearcut or burned by wildfire. Seedlings are grown at commercial nurseries from seed collected within the appropriate seed zones typically by FGS on its property, and/or purchased for the environmental conditions of each site where they will be planted.

*Vegetation Management*
Occasionally, sites may require one or more vegetation management treatments to reduce the impacts of unwanted competing vegetation on the growth of seedlings. Such treatments commonly involve the mechanical removal of competing brush species using tractors or hand crews. Brush is typically piled and burned or may be chipped. Herbicides are also used to accomplish management of competing vegetation; however, FGS is not seeking coverage of herbicides use as part of the ITPs.

### 2.1.10 Minor Forest Products

Minor forest products are occasionally harvested from the HCP area and transported over private and public roads. These products include, but are not limited to, Christmas trees and bows, mistletoe, firewood, fence posts, poles, yew bark, stumps, root wads, and mushrooms. These are all very minor components of the forest and are regulated by contract with FGS. The management of Christmas trees includes fertilizing, pruning, and growth control in scattered locations throughout the HCP area. The harvest of Christmas trees is small enough to be considered a minor forest product.

### 2.1.11 Fire Prevention and Suppression

Prevention of wildfire involves vegetation management and the construction of fuel breaks strategically located throughout the HCP area. The area forester designs and implements these activities according to site characteristics, which is generally very limited in scale. The prescription typically includes thinning for shaded fuel breaks along property lines or between watersheds. Wildfire suppression is typically under the authority of local, state, or federal agencies. In cases of escaped prescribed burns where local, state, or federal agencies are not involved, or for initial responses until responsible agencies have arrived, FGS will employ emergency fire suppression activities such as construction of fuel breaks by hand or bulldozer, lighting backfires, applying aerial fire suppressants, falling trees or snags, and water drafting for fire suppression.

### 2.1.12 Other Covered Activities

In addition to the forest management activities described above, FGS has proposed that the HCP and associated ITPs cover certain other activities undertaken by FGS and third parties pursuant to FGS obligations (for example, easements) or authorization (leases and licenses) in the future. Under California’s Timberland Productivity Act, a Timber Production Zone is for growing and harvesting of timber and other designated “compatible uses.” Other compatible uses and thus covered activities consistent with the objectives of the HCP may include, but are not limited to, watershed management; fish and wildlife habitat improvement; and use of roads, landings, and log decks. The specific activities that would be conducted at any particular location as part of watershed, fish, and wildlife habitat improvement cannot be specified in this Opinion as they occur irregularly and only as funding and resources are available.

However, in our analysis for this Opinion we have included representative activities such as slope stabilization, removal of passage barriers, instream habitat structure installation, and fencing of fish-bearing streams as minor activities in analyzing the effects of the proposed action.

### 2.1.13 Monitoring and Reporting

A detailed description of FGS's monitoring program for the HCP can be found in Chapter 7 and Appendix F of the HCP. The major components and objectives of the HCP monitoring program as a covered activity are described for this analysis with summary tables found in Table 2. In summary, the following monitoring components (compliance and effectiveness) of the HCP are considered covered activities of the ITP:

*Compliance Monitoring for Aquatic Covered Species*
Compliance monitoring for the aquatic species conservation strategy of the HCP consists of documenting compliance with the riparian, slope stability, road management, and other conservation measures (i.e., measures intended to avoid and minimize adverse effects to covered species).

*Compliance Monitoring Associated with Riparian Management.*

FGS proposes to minimize adverse effects to listed species during riparian management activities through a combination of measures specifying Watercourse and Lake Protection Zones (WLPZ) widths and restrictions on harvest (canopy coverage, tree retention) and activities (road building, soil disturbance) within WLPZs. Compliance with these measures will be documented through annual post-harvest WLPZ inspections of Class I (fish-bearing) and Class II (non fish-bearing) WLPZs where harvest has occurred in THPs for that year.

Post-Harvest WLPZ Inspections: FGS will conduct post-harvest inspections of randomly selected WLPZs where harvest has occurred within one year following harvest in approximately 10 percent of the WLPZs within active THPs for that year. These inspections will evaluate compliance, as implemented, with WLPZ management measures (e.g., WLPZ width, canopy coverage, tree retention, soil disturbance). Methods employed will be compatible with standard California forest monitoring protocols and FGS will report results to NMFS on an annual basis with a trend analysis conducted on five year intervals.

*Effectiveness Monitoring*.
Monitoring is necessary to evaluate the effectiveness of the aquatic conservation measures and to ensure that FGS achieves the biological goals and objectives established by the HCP for aquatic species, and to ensure that the effects of FGS' land management practices are not exceeding the levels of take of covered species as anticipated by NMFS

in this Opinion.  FGS's monitoring program for aquatic species consists of several elements that evaluate the effectiveness of the aquatic conservation measures by measuring changes in specific variables (watershed attributes) that affect the quantity and quality of habitats for the aquatic covered species.

The effectiveness monitoring program developed for the HCP, described in Table 3, includes the monitoring of water temperature, LWD recruitment, fine sediment loading, and changes in channel morphology and condition (FGS 2012).  Appendix B to this Opinion provides detail on some common instream monitoring techniques utilized to determine improvements or impairments from stream sedimentation.

**Table 2. Effectiveness Monitoring of the Proposed Fruit Grower's Supply Company Habitat Conservation Plan (FGS, 2012)**

| Physical/Biological Processes Assessed (Watershed Attributes) | Biological Goal | Monitoring Program Element | Time Frame for Results | Sampling Frequency | Sample Locations | Methods | Objectives |
|---|---|---|---|---|---|---|---|
| Stream temperature | Maintain a high level of stream shading to provide cool water temperature regimes consistent with the requirements of covered species. | Property-wide Summer Water Temperature Monitoring | > 5 years | Annually for up to 10 years and then at least 5 years each decade | 10-15 Sites within Cottonwood, Horse, Beaver, Moffett, Doggett, Dona, and Meamber drainages | Temperature data logger during summer/fall time period | (1) Provide a long-term record of water and air temperatures in key drainages.<br>(2) Provide a reference water temperature database that can be used, if needed, as the baseline in project level analyses.<br>(3) Evaluate observed water temperatures in relation to standards for suitability for salmonids utilizing standard Maximum Weekly Average Temperature or Maximum Weekly Maximum Temperature (MWAT and MWMT).<br>(4) Allow for an analysis of water temperature changes across the ownership in relation to FGS's management activities. |
| Stream temperature | Maintain a high level of stream shading to provide cool water temperature regimes consistent with the requirements of covered species. | Harvest Unit-level Water Temperature Monitoring | > 5 years | Annually, at least 2 years prior to harvest and up to five years post harvest | Approximately five sites in selected Class I and II reaches (10 total) with proposed timber harvest | Temperature data loggers at paired sites upstream and downstream of harvest units | (1) Demonstrate that stream temperatures do not change by more than 2°C relative to pre-harvest conditions as the stream moves through the treatment (harvest) unit.<br>(2) Demonstrate that any increases in stream temperatures within harvest units return to pre-harvest levels within 5 years of harvest. |
| Large Woody Debris | Provide for the recruitment of LWD into streams to maintain and allow the development of functional stream habitat conditions. | Riparian Stand Inventory | > 5 years | Once, immediately following harvest; repeated surveys at 5-year intervals | Up to 40 (10 annually) selected Class I and II reaches with WLPZ harvest | Inventory of permanent survey plots coupled with LWD modeling | (1) Demonstrate that harvest within Class I and Class II WLPZs does not reduce the potential volume of recruitment (immediately post-harvest) by greater than 10 percent compared to pre-harvest conditions.<br>(2) Demonstrate that harvest within Class I and II WLPZs does not reduce the potential volume of recruitment over the long term (i.e., 50 years) by greater than 10 percent compared to modeled "unmanaged" conditions. |
| Fine Sediments | Minimize and mitigate human-caused sediment inputs. | Channel substrate monitoring | > 5 years | Annually | Index reaches in Beaver, Horse, Moffett, and Cottonwood | Grid sampling / rapid V-star | Verify that fine sediment deposition (surficial and volume) does not increase over 5 or more years within channels influenced by covered activities. |

| Physical/Biological Processes Assessed (Watershed Attributes) | Biological Goal | Monitoring Program Element | Time Frame for Results | Sampling Frequency | Sample Locations | Methods | Objectives |
|---|---|---|---|---|---|---|---|
| | | | | | drainages | | |
| Fine Sediments | Minimize and mitigate human-caused sediment inputs. | Road inventories | > 10 years | Initial inventories followed by repeat inventories at 10 year intervals | All drainages with Class A and B designated lands | Inventory protocols developed by Pacific Watershed Associates and/or the California Department of Fish and Game | (1) Demonstrate that FGS's road inventories, prioritization, and treatment activities have resulted in a 50 percent reduction in the potential sediment delivery volume identified during the inventories over the first 20 years of the Permit Term.<br>(2) Demonstrate a reduction in hydrologic connectivity, and an increase in rocked surfacing on FGS' controlled roads. |
| Fine Sediments | Minimize and mitigate human-caused sediment inputs. | Road-related improvements | 1 year | Update of database as road improvements occur | Road improvement sites not directly linked to the road inventory and prioritization for treatment. | Maintain a GIS database that includes the description of the type of improvements made, methods used, and reductions in potential sediment delivery | Demonstrate that FGS's regular road maintenance, upgrading, and decommissioning activities have resulted in a reduction in hydrologic connectivity and potential sediment delivery volume. |
| Fine Sediments | Minimize and mitigate human-caused sediment inputs. | Mass wasting assessment | >15 years | 15 years, or event-driven | Sub-basins in the Horse, Beaver, and Cottonwood drainages | Aerial photo mapping with ground-based field verification | Verify that landslide frequency on areas/landforms subject to covered activities has not increased above similar, reference areas/landforms. |
| Channel Morphology and Conditions | Protect hydrologic and riparian processes that influence water quality, aquatic habitat, and riparian functions. | Channel condition assessment | 5 years | Initial assessment, repeated assessments at 5-year intervals | Index reaches in Beaver, Horse, Moffett, and Cottonwood drainages | Channel cross sections, sediment grain size, bank stability, LWD survey, channel morphology, aquatic habitat survey | Verify that geomorphic conditions and channel morphology in index reaches show a stable or improving trend indicating the overall effectiveness of the aquatic species conservation program. |

## 2.2 Changed Circumstances

NMFS and FGS identified several reasonably foreseeable circumstances under which changes could occur during the ITP term that could result in a substantial and adverse change in the status of a species covered by the HCP. The HCP contains supplemental prescriptive responses that must be taken by FGS for each reasonably foreseeable changed circumstance. These supplemental response actions carried out by FGS to a changed environmental condition (e.g., large fire or wind events) are covered activities under the HCP. Several types of changes are identified below as potential "changed circumstances" as defined in applicable federal regulations and policies:

- Global climate change, resulting in increased fire risk, flooding, drought, incidence of pests or pathogens, an increase in the number or density of invasive species, or restriction in the range of covered species at a regional or local scale. These issues are individually addressed in the sections below as they would pertain to changed circumstances in the plan area.
- Listing of species that are currently unlisted but occur within the HCP plan area.
- A change in the listing status (including de-listing) of a covered species through a formal status review by the Services.
- Designation of critical habitat for covered species during the permit term or designation of critical habitat for species listed after the start of the permit term that may be affected by a covered activity.
- Revision of critical habitat for covered species during the permit term that may be affected by a covered activity.
- Stand replacing fires that (alone or in combination with other events such as blow-down) affect greater than 150 feet, measured along the length of the stream, of previously standing timber within a Class I WLPZ or Special Management Zone (SMZ) along streams supporting any of the aquatic covered species in a given year.
- Stand replacing fire that (alone or in combination with other events such as blow-down) downgrades suitable habitat within the core area or home range of an activity center supported by a CSA on the FGS ownership to non-habitat, such that the CSA no longer provides demographic support to the federal conservation strategy or meets the biological objectives of the HCP.
- Complete blow-down that (alone or in combination with other events such as fire) affects greater than 150 feet, measured along the length of the stream, of previously standing timber within a Class I WLPZ or SMZ along streams supporting any of the aquatic covered species.
- Blow-down that (alone or in combination with other events such as fire) downgrades suitable habitat within the core area or home range of an activity center supported by a CSA on the FGS ownership to non-habitat, such that the CSA no longer provides

demographic support to the federal conservation strategy or meets the biological objectives of the HCP.

- Stand modification (e.g., changes in average diameter or canopy coverage) due to pests or pathogens, or their control, that (alone or in combination with other events such as fire and blow-down) downgrades suitable habitat within the core area or home range of an activity center supported by a CSA on the FGS ownership to non-habitat, such that the CSA no longer provides demographic support to the federal conservation strategy or meets the biological objectives of the HCP.
- Landslides that deliver greater than 1,000 cubic yards of sediment to a channel.
- Introduction or invasion by exotic plant or animal species (e.g., barred owl) that affect covered species or their habitat.

If any of the changed circumstances occur, FGS will implement the following supplemental prescriptions:

### 2.2.1 Climate Change

Despite variability in climate change simulations, consistent projections for warmer summers, reduced spring snowpack, and earlier and more rapid snowmelt suggest that forests in California and the Pacific Northwest will experience longer fire seasons and more frequent, extensive, and severe fires in the future (Flannigan et al. 2000, Lenihan et al. 2003,). In addition, a changing climate may result in perturbations to normal rainfall patterns, wind events, and precipitation driven landslide events. All of these may be response conditions to a changing climate over the permit term, and the magnitude and impacts of such events have been considered in the development of supplemental prescriptions described in more detail below.

### 2.2.2 Fire and Wind (With Respect to Aquatic Covered Species)

In the event that a stand-replacing fire affects the FGS ownership in drainages that support the aquatic covered species, or there is complete blow-down along greater than 150 feet of stream in a Class I WLPZ, FGS will provide NMFS with information regarding the damage within 30 days of detection and will identify areas where damage to a Class I WLPZ exceeds 150 feet of WLPZ along a stream. FGS, in consultation with NMFS, will determine if a changed circumstance for aquatic covered species has occurred, based on the quantity of habitat for aquatic covered species that has been altered and the potential for the event to adversely affect these species. If a changed circumstance affecting aquatic covered species occurs due to damage from fire or wind events of a magnitude within the range historically experienced in the plan area, FGS will apply the following supplemental prescriptions within the affected area of the drainage:

1) FGS will evaluate trees damaged or killed outright by fire or wind, including those in WLPZs and SMZs for salvage.
2) Salvage of trees downed or dead by fire or wind must comply with state law and other terms of this HCP (e.g., on unstable areas). Prior to conducting salvage operations within a WLPZ or SMZ, FGS must obtain NMFS' approval that the salvage would not lead to conditions where HCP biological goals and objectives could be compromised. No trees within the channel zone of a WLPZ may be removed. In addition, the conduct of any salvage operations within a WLPZ or SMZ will be done with reasonable care to minimize soil erosion, to retain structural features that contribute to bank or slope stability, and to retain standing dead trees

that will contribute to the recruitment of LWD to watercourses within the area affected by the fire.

3) FGS will replant any WLPZ or SMZ affected by the fire or wind as soon as reasonably possible except those areas where an established Equipment Exclusion Zone (EEZ) exists for the protection of Yreka phlox.

### 2.2.3 Landslides

If a landslide on the FGS ownership results in the delivery of more than 1,000 cubic yards of sediment to a channel (from either a source area, or from combined source area and propagated volumes), FGS will provide both Services with information regarding the landslide (e.g., location, size, potential to adversely affect covered species) within 10 days of its discovery. FGS and the Services will confer to determine from the available information if it is reasonably possible that FGS's management activities on or adjacent to the area of the landslide could have contributed to causing such landslide. If the Services and FGS conclude that it is reasonably possible that FGS's management activities contributed to the occurrence of the landslide, they will jointly review HCP harvest default measures on unstable areas to determine if changes to the measures are necessary. Where appropriate, the review may form the basis for changes to the default measures specified in the HCP.

### 2.2.4 Listing of a New Species or Designation of New Critical Habitat

If NMFS lists a new species or designates new critical habitat under the ESA subsequent to the effective date of the ITPs, and that species or critical habitat (1) is not a covered species or previously analyzed critical habitat, and (2) the species or habitat listing is affected by the covered activities, such listing or designation will constitute a changed circumstance. In this case, NMFS will reevaluate the ITP to determine if the HCP, the ITP, and the associated Opinion require modification. At that time, NMFS may deem it necessary to modify the covered activities to ensure that the covered activities are not likely to result in jeopardy to the newly listed, non-covered species or result in adverse modification or destruction of newly designated critical habitat. FGS shall implement the modifications to the HCP covered activities agreed upon with the Services to avoid the likelihood of jeopardy to the newly listed species or adverse modification of newly designated critical habitat. FGS shall continue to implement such modifications until such time as they apply for and NMFS approves an amendment of the ITP that covers the newly listed species or newly designated critical habitat, or until NMFS notifies FGS in writing that the modifications to the HCP covered activities are no longer required to avoid the circumstances described above.

*Change in the Listing Status of a Covered Species*

If the listing status of a covered species is changed (i.e., from threatened to endangered) through a formal status review during the permit term, the change in listing status will not require additional land, mitigation, restrictions, or compensation provided the HCP is being implemented in compliance with the take authorization conditions for that species. If a covered species' status is downgraded (i.e., from endangered to threatened) or the species is de-listed during the permit term then the HCP covered activities and conservation strategies may be modified, as appropriate, to reduce or eliminate required measures for that species provided such modifications are not likely to contribute to the re-listing of the species. FGS will continue to implement the HCP in accordance with all applicable provisions until such time they apply for and NMFS approves an amendment of the ITP.

*Revision of Critical Habitat*

NMFS designated critical habitat for SONCC coho salmon within areas potentially affected by the FGS HCP. If in the future, revisions to the SONCC coho salmon critical habitat designation are made that affect the HCP plan area, NMFS will not require FGS, without their permission, to make additional commitments of land, mitigation, restrictions, or compensation as long as the HCP is being properly implemented. Should additional species become listed during the permit term, it is possible that critical habitat for those species could be designated in the plan area. This changed circumstance is addressed above under "Listing of New Species."

## 2.3 Unforeseen Circumstances

Unforeseen circumstances are changes in circumstances affecting a species or geographic area covered by the HCP that could not reasonably have been anticipated by FGS, NMFS, and USFWS at the time the HCP was developed and negotiated, and that result in a substantial and adverse change in the status of a covered species (50 CFR 17.3 and 222.307(g)(3)(iii). The Services bear the burden of demonstrating that unforeseen circumstances exist, using the best scientific and commercial data available (50 CFR 17.22(b)(5) and 222.22(g)(3)). All changes not described above as "changed circumstances" that would result in a substantial and adverse change in the status of a covered species are unforeseen circumstances.

In case of an unforeseen event, FGS will immediately notify the Services. In determining whether such an event constitutes an unforeseen circumstance, the Services will consider, but not be limited to, the following factors: size of the current range of the affected species; percentage of range adversely affected by the HCP; percentage of range conserved by the HCP; ecological significance of that portion of the range affected by the HCP; level of knowledge about the affected species and the degree of specificity of the species' conservation program under the HCP; and whether failure to adopt additional conservation measures would appreciably reduce the likelihood of survival and recovery of the affected species in the wild (50 CFR 17.22(b)(5) and 222.307(g)(3)(iii).

If the Service(s) determine that additional conservation and mitigation measures are necessary to respond to the unforeseen circumstances, and the HCP is being properly implemented, the additional measures required will be, to the maximum extent practicable, as close as possible to the terms of the original HCP, and must be limited to modifications within any conserved habitat area or to adjustments within lands or waters that already are set-aside in the HCP's operating conservation program. Additional conservation and mitigation measures shall not involve the commitment of additional land or financial compensation, or restrictions on the use of land or other natural resources otherwise available for development or use under the original terms of the HCP without the consent of FGS (50 CFR 17.22(b)(5) and 222.307 (g)(3)(i), (ii).

## 2.4 Conservation Program (Covered Aquatic Species)

The aquatic conservation strategy is designed to avoid, minimize, and mitigate impacts to individual aquatic covered species and their habitats. The aquatic protection measures meet the combined objectives of the aquatic species conservation program described in section 5.2 of the HCP and are related to hydrology, riparian shading, large woody debris recruitment, and sediment control. Appendix A to this Opinion gives some detail of riparian stand conditions within the proposed HCP Plan Area. These conservation measures form the basis of FGS's Aquatic Conservation Program and are covered activities under the HCP and ITP.

### 2.4.1 Aquatic Protection Measures

FGS chose to adopt the 2008 CFPR's as a long-term conservation strategy for their HCP. NMFS requested that the 2008 CFPR rule numbers and tracked edits to the rules language be maintained as presented in the 2008 CFPR, but tailored to FGS's Class A (coho) and B (Chinook and steelhead) lands. The major components of the Aquatic Conservation Program are condensed for this analysis, with more detailed information provided in the HCP. A summary of the key conservation measures in the HCP's aquatic conservation program includes the following:

- Class I and II Watercourse and Lake Protection Zones to protect and restore healthy salmonid habitat conditions over time
- Retention requirements to protect trees with the highest likelihood to provide adequate LWD to Class I streams
- Restrictions on harvesting within Class I channels, except to promote improvements in salmonid habitat
- Limitations on heavy equipment operations in the wet weather season
- Protection of steep slopes prone to landsliding along Class I, II, and III (ephemeral) watercourses
- Requirements for effective erosion control measures to keep sediment out of watercourses that drain to salmonid streams
- Standards for drafting water for road dust abatement that protect and minimize disturbances to all life stages of salmonids
- Protection of trees providing shade to pools supporting coho
- Minimization on the construction of new roads within the plan area
- Road maintenance schedules that are tied to the protection of high value salmonid habitat
- Inventory and treatment of road erosion sources on a schedule that prioritizes high value salmonid watersheds with highest priority given to the most valuable coho watersheds
- Prioritization for the treatment of the few remaining road watercourse crossings that block fish passage within the plan area
- Careful consideration and planning in regards to the risks associated with timber operations on unstable slopes

### 2.4.2 Implementation Regions

For the purposes of implementation, the plan area has been divided at the drainage level into three "implementation classes" based primarily on the range and distribution of anadromous salmonid populations: Class A, B, and C lands. Table 3 identifies drainages and acres of FGS ownership in the FGS plan area and Table 4 gives the HCP implementation class for drainages in Class A and B FGS lands.

Class A lands (82,782 acres) include all fee-owned land, or lands in which FGS has timber rights within their Klamath River and Scott Valley Management Units that are located west of Interstate 5 and north of State Highway 3. These lands are located and in drainages that currently support coho salmon or, based on the best available information, historically supported coho salmon. Class A designated lands include those portions of the HCP area where covered activities can substantially influence habitat conditions for coho salmon in particular, based on the location of the FGS ownership relative to the distribution of coho salmon. Class A lands can also support populations of Chinook salmon and KMP steelhead however, the focus of the aquatic conservation strategy is for coho, which are the most sensitive of the three covered species to alterations of habitat. Class A lands generally include stream reaches that are direct tributaries to the Klamath or Scott Rivers and support, or historically supported coho salmon or that are directly upstream of these coho salmon reaches. Class A lands also include the FGS ownership in the Cottonwood Creek drainage, which currently does not support coho or Chinook salmon, but does support KMP steelhead. This drainage, at present, is blocked to coho and Chinook access as a result of agricultural diversions just upstream from its confluence with the Klamath River near the town of Hornbrook.

Class B lands (20,542 acres) include all fee-owned lands, or lands in which FGS has timber rights in the Bogus Creek and Willow Creek drainages, and that portion of the Moffett Creek drainage that lies south of State Highway 3. These lands are located in drainages that are within the range of anadromy, but currently do not support coho salmon near FGS lands and have no real potential to do so in the future. Most of these FGS land holdings are located high up in the watersheds with stream gradients steeper than that utilized by coho, or the FGS land holdings are so small that covered activities on these parcels have little ability to influence coho salmon habitat downstream. Class B lands can influence populations of KMP steelhead however, and to a small degree the Klamath and Trinity Rivers Chinook salmon population in Bogus Creek.

Class C lands (49,925 acres) include all fee-owned lands, or lands in which FGS has timber rights located in the Elliott Creek drainage and those lands in drainages east of Interstate 5 (Grass Lake Management Unit), except in the Bogus Creek and Willow Creek drainages (described above as Class B lands). Most of these lands are located above long-standing natural barriers to anadromous fish or have no direct connection to streams supporting anadromous salmonids. Consequently, there is virtually no potential for covered activities to influence habitat conditions for coho salmon and no opportunity for the FGS ownership to contribute to the recovery of coho salmon. In general, almost all Class C lands may affect water quality in downstream areas occupied by covered aquatic species, but FGS's management activities in these watersheds have low likelihood of directly or indirectly adversely affecting the covered species. Figure 2 shows the three management units in the HCP Plan Area and the drainages that feed them.

**Table 3. Drainages with Fruit Growers Supply Company lands included in each Implementation Class**

| Implementation Class | Drainage Name | FGS Ownership (acres) |
|---|---|---|
| A | Beaver | 16,936 |
| A | Big Ferry | 1,281 |
| A | Canyon | 1,973 |
| A | Cottonwood | 16,537 |
| A | Doggett | 3,992 |
| A | Dona | 2,518 |
| A | Dutch Creek | 2,987 |
| A | Empire Creek | 2,677 |
| A | Horse | 9,695 |
| A | Indian | 3,952 |

| Implementation Class | Drainage Name | FGS Ownership (acres) |
|---|---|---|
| A | Lumgrey Creek | 2,519 |
| A | Meamber | 5,059 |
| A | Middle Klamath | 1,434 |
| A | Mill | 1,437 |
| A | Moffett | 3,503 |
| A | Pat Ford | 2,172 |
| A | Patterson | 2,103 |
| A | Rattlesnake | 1,068 |
| A | Seiad | 1,445 |
| B | Bogus Creek | 1,982 |
| B | Duzel | 11 |
| B | EF Scott | 186 |
| B | McConaughy | 124 |
| B | Moffett | 14,941 |
| B | Shasta Valley | 545 |
| B | Willow Creek | 979 |
| C | Antelope Creek | 362 |
| C | Antelope Sink | 1,558 |
| C | Elliott Creek | 4,490 |
| C | Fourmile Hill | 749 |
| C | Garner Mtn | 1,399 |
| C | Glass Mtn | 1,985 |
| C | Grass Lake | 12,127 |
| C | Headwaters | 4,748 |
| C | Horsethief | 6,648 |
| C | Juanita Lake | 2,048 |
| C | Little Shasta | 6,159 |
| C | NW Mt Shasta | 3,344 |
| C | Shasta Woods | 4,506 |

**Table 4. List of Watersheds Included in the Action Area by HCP Implementation Classification**

| Historic or Current Coho Population | FGS Implementation Class |
|---|---|
| **Upper Klamath River** | |
| Beaver | A |
| Cottonwood | A |
| Doggett | A |
| Dona | A |
| Dutch Creek | A |
| Empire Creek | A |
| Horse | A |
| Lumgrey Creek | A |
| Middle Klamath | A |
| Seiad | A |
| Willow Creek | B |
| Bogus Creek | B |
| **Scott River** | |
| Big Ferry | A |
| Canyon | A |
| Indian | A |
| Meamber | A |
| Mill | A |
| Moffett | A |
| Pat Ford | A |
| Patterson | A |
| Rattlesnake | A |
| Duzel | B |
| EF Scott | B |
| McConaughy | B |
| Shasta Valley | B |
| Moffett | B |

The standard aquatic protection measures on Class A (coho) and Class B (Chinook and steelhead) lands under this HCP include the Protection Measures in Watersheds with Coho Salmon (14 CCR section 787.2) specified in Appendix I of the 2008 CFPRs. Within Class A lands, the Measures to Facilitate Incidental Take Authorization in Watersheds with Coho Salmon, also described in Appendix I of the 2008 CFPRs, will apply in addition to the rules under 14 CCR § 936.9.1. These rules for coho salmon were developed by the California Department of Fish and Game (CDFG) for the protection of coho salmon, a state listed threatened species, and adopted by the State of California. As of February, 2012 these coho rules have been repealed due to litigation and have been replaced by new CFPR's for the protection of anadromous salmonids ("ASP Rules"). Regardless of the coho rule litigation, FGS has chosen to apply the coho protection rules as a keystone component of the aquatic conservation strategy in their HCP. On Class C (non-anadromous) lands, FGS will apply the CFPRs for non-coho watersheds.

### 2.5 Action Area

For this analysis, the action area includes the Klamath River Management Unit (including Bogus and Willow Creeks), Scott Valley Management Unit, and the area one (1) mile downstream of the confluence of the Scott and Klamath Rivers (see Figure 2). This delineation of action area is based upon the expected extent of habitat that could be directly or indirectly affected by the proposed action and the likelihood that individuals of covered species could be affected by the Proposed Action. Delivery of sediment to watercourses adjacent to and downstream of plan area lands as a result of implementation of the HCP from activities such as road building, road maintenance, and harvest-related landslides is likely to have the most far-reaching effects on salmonid habitat and individuals exposed to this particular stressor. NMFS expects that salmonids and their habitat are not likely to respond to sediment generated from the plan area beyond one mile downstream of the plan area. That is, the action area includes the plan area and the downstream extent of any plan-related sediment plume, up to and including one mile downstream from the plan area. This one-mile extent of a plan area sediment plume would likely only be detectable should the sediment generating event(s) occur during a small to mid-scale winter storm, and less likely during a spring or summer storm which are infrequent within the action area. During large winter storms, sediment delivery from numerous locations upstream of the plan area would likely occur, generating turbid mainstem waters. Discerning the relative portion of sediment generated from the plan area versus upstream sources in the mainstem of the Klamath River would be very difficult to determine; thus the action area selected for analysis is derived from an assumption that visual detection of a significant sediment plume generated from the plan area is likely only discernible for the one-mile length discussed above.

The Shasta River is not included in the action area analyzed in this Opinion as FGS operations cannot impact covered species habitat in this watershed. Shasta River populations of covered species migrate through the mainstem Klamath River corridor downstream of FGS lands, but exposure to stressors caused by implementation of the HCP are likely to be insignificant to individuals migrating through the action area. Again, the most likely HCP-related stressor that fish utilizing the mainstem Klamath are exposed to from FGS operations is sediment. In most cases, sediment generated from the plan area that reaches the mainstem Klamath River is going to occur during winter storms during a period in which sediment from upstream sources is also being delivered. Adult coho, steelhead, and Chinook who are migrating to spawning grounds in the Shasta River are frequently exposed to sediment during late fall and winter migrations, but discerning the exposure to individuals from upstream sources of sediment versus plan area generated sediment is not practically possible. The same conditions would also apply to overwintering Shasta River steelhead and coho juveniles who may be occupying habitat in the mainstem Klamath River during the winter period when sediment is being delivered. The probability that Shasta River covered species are exposed to the effects of implementation of the HCP in a discreet manner is likely very low and therefore the effects of individuals exposed to HCP-related sediment is insignificant and discountable.

Also discussed in the HCP are several parcels of land situated on the northern flanks of Mt. Shasta (Grass Lake Management Unit). Many of these areas drain into closed depressions and have never provided historic access to anadromous salmonids. One additional stream, Elliot Creek, is a tributary to the Applegate-Rogue River basin in southern Oregon and lies above Applegate Lake, which prohibits anadromous access to the reaches affected by the proposed HCP. Table 5 lists the watersheds and their implementation classification included in the action area where effects to covered species will be analyzed. Class C lands are considered part of the action area as covered activities will be carried out in this region. However, given their location outside of the range of anadromous salmonids, and their limited potential to affect listed salmonids given the distance of covered activities to potential habitat, NMFS determined that analyzing effects to covered species from implementation of the HCP is not warranted on Class C lands as any measurable effects to individuals or habitat is likely not possible to detect or determine.

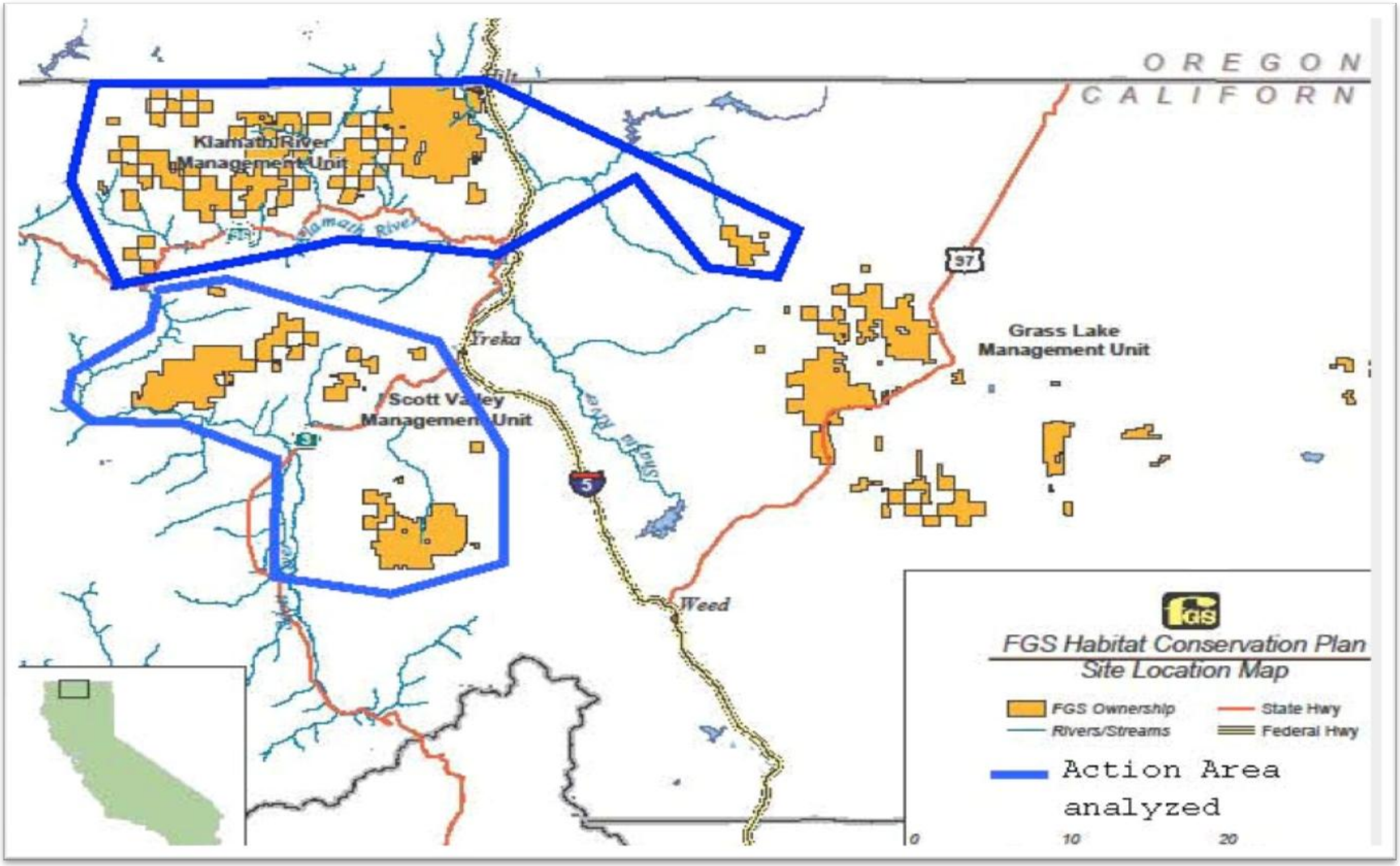


**Figure 2. Approximate Action Area for Section 7 Analysis**

# 3 ANALYTICAL APPROACH

## 3.1 Introduction

This section describes the analytical approach used by NMFS to evaluate the effects of the proposed action on listed and unlisted species under NMFS' jurisdiction. The approach is intended to ensure that NMFS comports with the requirements of statute and regulations when conducting and presenting the analysis. This includes the use of the best available scientific and commercial information relating to the status of the species and critical habitat and the effects of the proposed action.

The following sub-sections outline the specific conceptual framework and key steps and assumptions utilized in the listed species jeopardy risk assessment and the critical habitat destruction or adverse modification risk assessment for SONCC coho. Wherever possible, these sections were written to apply to all three aquatic species, and associated designated critical habitat, occurring in the action area, which include:

- Threatened Southern Oregon/Northern California Coast (SONCC) coho salmon (*O. kisutch*), and its designated critical habitat
- Unlisted Upper Klamath and Trinity Rivers Chinook salmon (*O. tshawytcha*)
- Unlisted Klamath Mountains Province (KMP) steelhead (*O. mykiss*)

The following discussion of our analytical approach is organized into several sub-sections, with the first sub-section describing the legal framework provided by the ESA and case law and policy guidance related to Section 7 consultations. Second, a general overview of how NMFS conducts its Section 7 analysis is described, including various conceptual models of the overall approach and specific features of the approach are discussed. This includes information on tools used in the analysis specific to this consultation. We first describe our listed species analysis as it pertains to individual fish species and the physical, chemical, and biotic changes to the ecosystem caused by the proposed action. Description of our critical habitat analysis follows. Third, we discuss the data available for the analysis, the related uncertainties, and critical assumptions NMFS made to bridge data gaps in the information provided to initiate consultation. Fourth, we diagram the overall conceptual approach in the assessment to address the integration of all available information and decision frameworks to support our assessment of the effects of the proposed action. Finally, we discuss the presentation of all of these analyses within this Opinion to provide a basic guide to the reader on the relevant sections where the results of specific analytical steps can be reviewed.

## 3.2 Legal and Policy Framework

The purposes of the ESA, "…*are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of this section*." To help achieve these purposes, the ESA requires that, "*Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the* *continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat…*"

***Jeopardy Standard.*** The "jeopardy" standard has been further interpreted in regulation (50 CFR 402.02) as a requirement that Federal agencies insure that their actions are not likely to result in *appreciable reductions in the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution*. It is important to note that the purpose of the analysis is to determine whether or not appreciable reductions are reasonably expected. For the purposes of this analysis, NMFS equates a listed species' probability (or risk) of extinction with the likelihood of both the survival and recovery of the species in the wild for purposes of conducting jeopardy analyses under Section 7(a)(2) of the ESA. In the case of listed salmonids, we use the Viable Salmonid Populations (VSP) framework (McElhany et al. 2000) as a bridge to the jeopardy standard after an analysis of potential impacts to individuals within sub-populations from implementation of a proposed action has been conducted. A designation of "a high risk of extinction" or "low likelihood of becoming viable" indicates that the species faces significant risks from internal and external processes that can drive it to extinction. The status assessment considers and diagnoses both the internal and external processes affecting a species' extinction risk.

For salmonids, the four VSP parameters are important to consider because they are predictors of extinction risk, and the parameters reflect general biological and ecological processes that are critical to the survival and recovery of the listed salmonid species (McElhany et al. 2000). The VSP parameters of productivity, abundance, and population spatial structure are consistent with the "reproduction, numbers, or distribution" criteria found within the regulatory definition of jeopardy (50 CFR 402.02) and are used as surrogates for "numbers, reproduction, and distribution." The VSP parameter of diversity relates to all three jeopardy criteria. For example, numbers, reproduction, and distribution are all affected when genetic or life history variability is lost or constrained, resulting in reduced population resilience to environmental variation at local or landscape-levels.

NMFS is currently in the process of developing a recovery plan for SONCC coho salmon. A technical recovery team (TRT) was established to assist in the effort. One of the TRT products, Williams et al. (2008), provides a "Framework for Assessing Viability of threatened Coho Salmon in the Southern Oregon/Northern California Coast Evolutionary Significant Unit." Along with assessing the current viability of the listed SONCC coho, Williams et al. (2008) provided recommendations for recovering this species. A public review draft of the NMFS recovery plan for SONCC coho was issued in January, 2012. Williams et al. (2008) was relied on to establish the current status of SONCC coho, and both Williams et al. (2008) and the preliminary draft recovery plan were utilized to evaluate whether the proposed action does not "reduce appreciably the likelihood of survival and recovery" of SONCC coho. Because KMP steelhead and Klamath and Trinity Rivers Chinook are unlisted species, TRTs have not been formed for these ESU's, and thus, no ESU-specific population viability assessments have been conducted by NMFS. For this Opinion however, NMFS incorporated the population viability concepts and extinction risks outlined in McElhany et al. (2000) in our analysis of whether the proposed action reduces appreciably the likelihood of survival and recovery for these two ESU's.

***Destruction or Adverse Modification Standard.*** For critical habitat, NMFS did not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02 as it was invalidated by the 9th Circuit Court of Appeals in 2004. Instead, we have relied upon the statutory provisions of the ESA to complete the analysis with respect to critical habitat. NMFS will evaluate "destruction or adverse modification" of critical habitat by determining if the action reduces the value of critical habitat for the conservation of the species.

Additional requirements on the analysis of the effects of an action are described in regulation (50 CFR 402) and our conclusions related to "jeopardy" and "destruction or adverse modification" generally require an expansive evaluation of the direct and indirect consequences of the proposed action, related actions, and the overall context of the impacts to the species and habitat from past, present, and future actions, as well as the condition of the affected species and critical habitat [for example, see the definitions of "cumulative effects," "effects of the action," and the requirements of 50 CFR 402.14(g)].

Recent court cases have reinforced the requirements provided in Section 7 regulations that NMFS must evaluate the effects of a proposed action within the context of the current condition of the species and critical habitat, including other factors affecting the survival and recovery of the species and the functions and value of critical habitat. In addition, the courts have directed that our risk assessments consider the effects of climate change on the species and critical habitat and our prediction of the future impacts of a proposed action.

## 3.3 General Overview of the Approach Used

NMFS uses a series of sequential analyses to assess the effects of Federal actions, which in this case would be NMFS issuing an ITP to FGS for its covered activities, on threatened species and designated critical habitat. The first step in our analysis identifies those physical, chemical, or biotic aspects of proposed actions that are likely to have individual, interactive, or cumulative direct and indirect effects on the environment (we use the term "stressors" for these aspects of an action). As part of this step, we identify the spatial extent of any potential stressors and recognize that the spatial extent of those stressors may change with time (the combined spatial extent of these stressors is the "action area" for a consultation).

In the second step of our analyses NMFS identifies the endangered species, threatened species, species proposed for listing or designated or proposed critical habitat that are likely to occur in the same space and at the same time as these potential stressors. For the purposes of HCPs where unlisted species are included as covered species in the ITP, NMFS analyzes effects to the unlisted species (e.g., KMP steelhead) as if they were proposed for listing. We then evaluate the nature of the co-occurrence of the covered species and their critical habitat with the stressors (and subsidies) of the proposed action over time (these represent our *exposure analyses*). In this step of our analyses, we try to identify, when possible, the number and age (or life stage) of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent or the specific areas and primary constituent elements of critical habitat that are likely to be exposed.

Once we identify which listed or unlisted resources are likely to be exposed to potential stressors associated with an action and the nature of that exposure, in the third step of our analyses, we examine the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure (these represent our *response analyses*). The final steps of our analyses - establishing the risks those responses pose to listed resources - are different for listed species and designated critical habitat and are further discussed in the following sub-sections (these represent our *risk analyses*).

### 3.3.1 Application of the Approach to Listed Species Analyses

Our jeopardy determinations must be based on an action's effects on the continued existence of a threatened or endangered species as it was listed. Because the continued existence of listed species depends on the fate of the populations that comprise them, the probability of extinction, or probability of persistence of listed species depends on the probabilities of extinction and persistence of the populations that comprise the species. Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them; populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

Our analyses reflect these relationships between listed species and the populations that comprise them, and the individuals that comprise those populations. We identify the probable risks that actions pose to listed individuals that are likely to be exposed to an action's effects. Our analyses then integrates those individuals risks to identify consequences to the populations those individuals represent. Subsequently, this population level analysis is then integrated into the VSP jeopardy analysis previously described.

We measure risks to listed individuals using the individual's "fitness," which are changes in an individual's growth, survival, annual reproductive success, or lifetime reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual's probable response to an action's effects on the environment (which we identify in our *response analyses*) are likely to have consequences for the individual's fitness.

When individuals, whether they are listed plants or animals, are expected to experience reductions in fitness, we would expect those reductions to also reduce the abundance, reproduction rates, or growth rates (or increase variance in one or more of these rates) of the populations those individuals represent (see Stearns 1992). Reductions in one or more of these variables (or one of the variables we derive from them) is a *necessary* condition for increases in a population's probability of extinction, which is itself a *necessary* condition for increases in a species', or in this case ESU's, probability of extinction. If we conclude that listed animals are likely to experience reductions in their fitness, our assessment tries to determine if those fitness reductions are likely to be sufficient to increase the probability of extinction of the populations those individuals represent (measured using changes in the populations' abundance, reproduction, diversity, spatial structure and connectivity, growth rates, or variance in these measures to make inferences about the population's extinction risks). In this step of our analyses, we use the population's base condition (established in the *Status of the Species* section of this Opinion) as our point of reference. Generally, this reference condition is a measure of how near to or far from extinction or recovery a species is.

An important tool we use in this step of the assessment is a consideration of the life cycle of the species. The consequences on a population's probability of extinction as a result of impacts to different life stages are assessed within the framework of this life cycle and our current knowledge of the transition rates (essentially, survival and reproductive output rates) between stages, the sensitivity of population growth to changes in those rates, and the uncertainty in the available estimates or information. An example of a Pacific salmonid life cycle to be considered in this type of analysis is provided in Figure 3.

Various sets of data and modeling efforts are useful to consider when evaluating the transition rates between life stages and consequences on population growth as a result of variations in those rates. Where available, information on transition rates, sensitivity of population growth rate to changes in these rates, and the relative importance of impacts to different life stages is used to inform the translation of individual effects to population level effects. Generally, however, we assume that the consequences of impacts to older reproductive and pre-reproductive life stages are more likely to affect population growth rates than impacts to early life stages. But it is not always the adult transition rates that have the largest effect on population growth rate. For example, absolute changes in the number of smolts that survive their migration to the ocean may have the largest impact on Chinook salmon population growth rate (Wilson 2003) followed by the number of alevins that survive to fry stage.

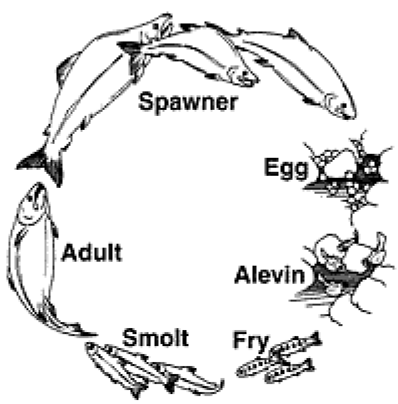


**Figure 3. Conceptual diagram of the life cycle of a Pacific salmonid (from http://www.pac.dfo-mpo.gc.ca/fm-gp/species-especes/salmon-saumon/facts-infos/cycle-eng.htm).**

In addition, we recognize that populations may be vulnerable to small changes in transition rates. As hypothetically illustrated in Figure 4, small reductions across multiple life stages can be sufficient to cause the extirpation of a population through the reduction of future abundance and reproduction of the species.

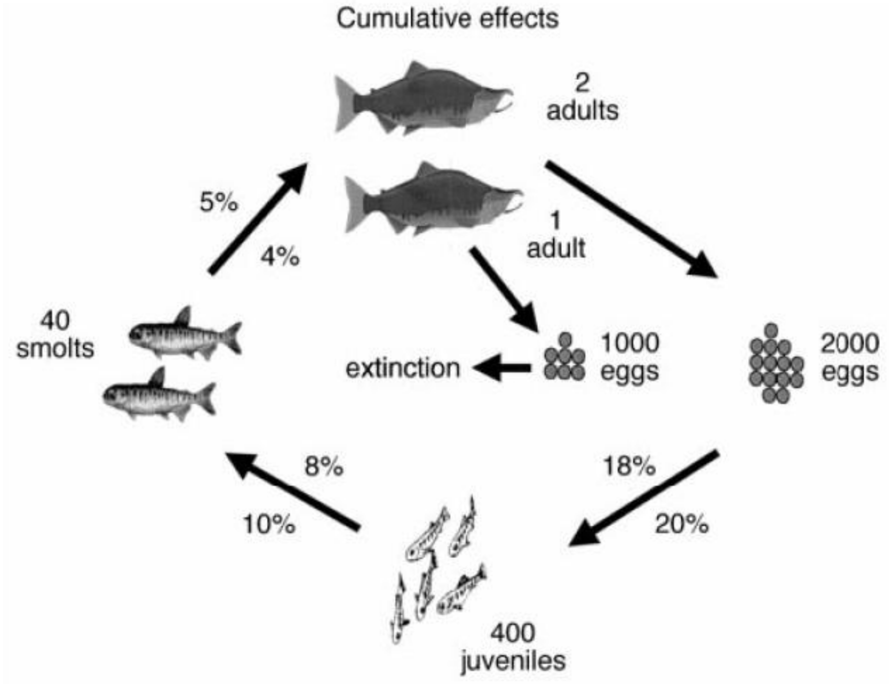


**Figure 4. Illustration of cumulative effects in the form of varying survival rates for different life stages of Pacific salmon (Naiman and Turner 2000).**

Finally, our assessment evaluates if changes in population viability are likely to reduce the viability of the species those populations comprise. In this step of our analyses, we use the species' status (established in the *Status of the Species* section of this Opinion) as our point of reference. We also use our knowledge of the population structure of the species to assess the consequences of the increase in extinction risk to one or more of those populations. Our *Status of the Species* section discusses the available information on the structure and diversity of the populations that comprise the listed and unlisted species (covered species) and any available guidance on the role of those populations in the recovery of the species. Further guiding the analysis of effects from the proposed action on the SONCC coho ESU, the SONCC TRT recommended that efforts be made to "Secure all extant populations. Although the SONCC ESU (*sic*) is far short of being viable, extant populations, even if not currently viable, may be needed for recovery" (Williams et al. 2008). We therefore assume that if appreciable reductions in any population's viability are expected to result from implementation of the proposed action, then this would be expected to appreciably reduce the likelihood of both the survival and recovery of the diversity group the population belongs to as well as possible the listed ESU. In a stepwise summary approach to how we analyze the effects from the proposed action on individuals of the covered species we perform the following, generally:

- Determine the division of the project location and the species potentially exposed to project related stressors;
- Determine which life history stage(s) could be potentially exposed to identified stressors;
- Anticipate the timing of particular life history stages and potential exposure to stressors;
- Estimate the stressor(s) frequency, intensity, and duration for an exposure analysis;

- Identify if there is an existing stress regime to which individuals of particular life history stages are already exposed;
- Determine if there will be interactions between existing stressors and project stressors on exposed individuals;
- Determine short-term responses of individuals to stressors including project related stressors;
- Determine long-term responses of individuals to stressors including project related stressors; and
- Determine if the stressor and exposure scenarios anticipated are expected to result in a probable reduction in fitness of the individuals exposed.

*The Viable Salmonid Populations Framework in Listed Salmonid Analyses*

In order to assess the survival and recovery of any species, a guiding framework that includes the most appropriate biological and demographic parameters is required. For Pacific salmon, McElhany et al. (2000) defines viable salmonid population as:

> "an independent population…that has negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year time frame,"

The VSP concept provides specific guidance for estimating the viability of populations and larger-scale groupings of Pacific salmonids such as ESU or Distinct Population Segment (DPS). Four VSP parameters form the key to evaluating population and ESU/DPS viability: (1) abundance; (2) productivity (*i.e.*, population growth rate); (3) population spatial structure; and (4) diversity (McElhany et al. 2000). In addition, the condition and capacity of the ecosystem upon which the population (and species) depends plays a critical role in the viability of the population or species. Without sufficient space, including accessible and diverse areas the species can utilize to weather variation in their environment, the population and species cannot be resilient to chance environmental variations and localized catastrophes. As discussed in the *Status of the Species*, salmonids have evolved a wide variety of life history strategies designed to take advantage of varying environmental conditions. Loss or impairment of the species' ability to utilize these adaptations increases their risk of extinction.

As presented in Good et al. (2005), criteria for VSP are based upon measures that reasonably predict extinction risk and reflect processes important to populations. Abundance is critical because small populations are generally at greater risk of extinction than large populations. Stage-specific or lifetime productivity (*i.e.*, population growth rate) provides information on important demographic processes. Genotypic and phenotypic diversity are important in that they allow species to use a wide array of environments, respond to short-term changes in the environment, and adapt to long-term environmental change. Spatial structure reflects how abundance is distributed among available or potentially available habitats, and can affect overall extinction risk and evolutionary processes that may alter a population's ability to respond to environmental change.

The VSP concept also identifies guidelines describing a viable ESU/DPS. The viability of an ESU or DPS depends on the number of populations within the ESU or DPS, their individual status, their spatial arrangement with respect to each other and to sources of potential catastrophes, and diversity of the populations and their habitat (Williams et al. 2008). Guidelines describing what constitutes a viable ESU are presented in detail in McElhany et al. (2000).

Along with the VSP concept, NMFS uses a conceptual model of the species to evaluate the potential impact of proposed actions. For the species, the conceptual model is based on a bottom-up hierarchical organization of individual fish at the life stage scale, population, diversity group, and ESU/DPS. The guiding principle behind this conceptual model is that the viability of a species (e.g., ESU) is dependent on the viability of the diversity groups that compose that species and the spatial distribution of those groups; the viability of a diversity group is dependent on the viability of the populations that compose that group and the spatial distribution of those populations; and the viability of the population is dependent on the four VSP parameters, and on the fitness and survival of individuals at the life stage scale. The anadromous salmonid life cycle (Figure 3) includes the following life stages and behaviors, which will be evaluated for potential effects resulting from the proposed action: adult immigration and holding, spawning, embryo incubation, juvenile rearing and downstream movement, and smolt outmigration.

### 3.3.2 Application of the Approach to Critical Habitat Analyses

The basis of the "destruction or adverse modification" analysis is to evaluate whether the proposed action results in negative changes in the function and role of the critical habitat in the conservation of the species. Our evaluation of habitat conservation value entails an assessment of whether the essential habitat features are functioning to meet the biological requirements of the listed species, or how far the features are from this condition. As a result, NMFS does not base our evaluation of destruction or adverse modification to critical habitat on how individuals of the species will respond to changes in habitat quantity and quality, but rather on how affected areas and functions of critical habitat essential for the conservation of the species could change. If an area encompassed in a critical habitat designation is likely to be exposed to the direct or indirect consequences of the proposed action on the natural environment, we ask if constituent elements included in the designation (if there are any) or physical, chemical, or biotic phenomena that give the designated area value for the conservation of the species are likely to respond to that exposure. In particular we are concerned about responses that are sufficient to reduce the quantity, quality, or availability of those constituent elements or physical, chemical, or biotic phenomena in such a manner that the response threatens the conservation of the species. We recognize that the realized conservation value of critical habitat is a dynamic property that changes over time in response to changes in land use patterns, climate (at several spatial scales), ecological processes, changes in the dynamics of biotic components of the habitat, as well as other factors.

At the heart of the analysis is the basic premise that the conservation value of an overall critical habitat designation is the sum of the values of the components that comprise the habitat. For example, the conservation value of listed salmonid critical habitat is determined by the conservation value of the watersheds that make up the designated area. In turn, the conservation value of the components is the sum of the value of the primary constituent elements (PCEs) that make up the area. Primary constituent elements are specific areas or functions, such as spawning or rearing habitat, that support different life history stages or requirements of the species. The conservation value of the PCE is the sum of the quantity, quality, and availability of the essential features of that PCE. Essential features are the specific processes, variables, or elements that comprise a PCE. Thus, an example of a PCE would be spawning habitat and the essential features of that spawning habitat would be conditions such as clean spawning gravels, appropriate timing and duration of certain water temperatures, and water free of pollutants.

As with the outline of our summary approach to how we analyze the effects from the proposed action on individuals, we perform the following steps in determining effects from the proposed action on designated critical habitat:

- Determine the division of the project location and the critical habitat potentially exposed to project related stressors;
- Determine the area or features of critical habitat that could be affected by the proposed project;
- Determine which primary constituent elements could be affected by project related stressors;
- Estimate the stressor(s) frequency, intensity, and duration of exposure to critical habitat,
- Identify if there is an existing stress regime to which critical habitat in the action area is already exposed;
- Determine if there will be interactions between existing stressors and project stressors on critical habitat;
- Determine short-term responses of critical habitat to stressors including project related stressors;
- Determine long-term responses of critical habitat to stressors including project related stressors; and
- Determine if the stressor and exposure scenarios anticipated are expected to result in a probable reduction in the quantity, quality, or function of critical habitat in the action area.

If the proposed action results in reductions in the quantity, quality, or availability of one or more essential features that reduces the value of the PCE, which in turn reduces the function of the designated areas, which in turn reduces the function of the overall critical habitat designation in its relation to conservation of the species, then we will conclude that the proposed action is likely to produce an adverse modification or destruction of critical habitat. In the strictest interpretation, reductions to any one essential feature or PCE would equate to a reduction in the value of the whole. However, there are other considerations. We look to various factors to determine if the reduction in the value of an essential feature or PCE would affect the ability of critical habitat to provide for the conservation of the species. For example:

- The timing, duration and magnitude of the reduction;
- The permanent or temporary nature of the reduction; or
- Whether the essential feature or PCE is limiting (in the action area or across the designation) to the recovery of the species or supports a critical life stage in the recovery of the species (for example, juvenile survival is a limiting factor in recovery of the species and the habitat PCE supports juvenile survival).

In this assessment, we combine information about the contribution of critical habitat PCEs (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) to the conservation value of those areas of critical habitat that occur in the action area, given the physical, chemical, biotic, and ecological processes that produce and maintain those PCEs in the action area. We use the conservation value of those areas of designated critical habitat that occur in the action area as our point of reference for this comparison. For example, if the critical habitat in the action area has limited current value or potential value for the conservation of listed species that limited value is our point of reference for our assessment of the consequences of the added effects of the proposed action on that conservation value.

### 3.3.3 Approach of the Assessment Used for the Proposed Action (Issuance of an ITP and Implementation of the FGS HCP)

To assess the effects of the proposed action, we ask the following series of questions:

1) what are the physical and biologic processes that are likely to be directly or indirectly affected by the land management activities associated with the proposed action over the 50-year duration of the ITP?

2) how are those processes likely to respond to the activities proposed in the HCP?

3) how are the responses of those physical and biologic processes likely to affect the quality, quantity, and availability of the habitat conditions for salmon in the action area?

4) what threatened or endangered species of Pacific salmon are likely to be exposed to those changes in the quality, quantity, and availability of their habitat conditions?

5) how are the different life stages of those salmon likely to respond to those changes in habitat conditions, expressed in terms of the fitness (specifically, the growth, survival, and lifetime reproductive success) of these salmon?

6) what are the probable consequences of any changes in the fitness of these salmon on the viability of the populations those salmon represent? and;

7) what are the probable consequences of any changes in the viability of those salmon populations on the viability of the salmon species themselves?

To answer these questions, we utilized information provided by FGS as well as information gained from numerous literature searches and professional judgment. The following discussion briefly summarizes the approach we took to answer each question and the assumptions or assessments we made to complete the analysis.

1) *What are the physical, chemical, and biotic processes that are likely to be directly or indirectly affected by the land management activities associated with the proposed action over the 50-year duration of the ITP?*

Our assessment is structured around the physical and biologic processes that dictate habitat conditions in the action area. We use the best scientific and commercial data available to determine whether the proposed activity affects the processes discussed in the *Environmental Baseline* section including:

A. Hydrologic Regime
B. Habitat Access
C. LWD Recruitment Processes
D. Sediment Flux
E. Thermal Inputs and Stream Temperature Regimes
F. Nutrient and Contaminant Flux
G. Disease, Predation and Competition

We use these processes as indicators of the physical, chemical, and biotic controls on habitat conditions that salmonids depend on for their survival. To develop an empirical LWD source-distance curve applicable to the plan area and FGS' silvicultural methods, a spreadsheet model was developed to calculate the potential contribution (volume) of LWD from any stand, given the diameter and height distribution of trees in the stand. The model utilizes standard geometric equations (e.g., Van Sickle and Gregory 1990) to determine the potential contribution of any tree given its diameter and height and its distance (randomly generated) from the stream edge (see FGS HCP for a complete description of the model). The modeled stand was developed from stand inventory data for an actual stand in the Cottonwood drainage, and is representative of approximately 60 percent of the stands currently found in the plan area. To determine the "site potential" of this stand, its growth was modeled using ORGANON for a period of 50 years with no management. In this way, the analysis accounts for tree growth through which trees become "recruitable" and provide more potential LWD volume as time passes. Thus, the modeled stand represents an estimate of the long-term recruitment potential of riparian stands in the HCP area

2) *How are those processes likely to respond to the activities proposed in the HCP?*

The interactions of the various processes with stream reaches in the action area will be influenced by many of the activities proposed in the HCP. The effects analysis examines the flow regimes, access limitations, wood recruitment patterns, sediment delivery rates, temperature regimes, nutrient dynamics and biologic processes likely to result from implementing the proposed HCP.

For example, many of the proposed activities in the HCP will influence sediment delivery rates. Thus, we look at the various activities that have the potential to influence sediment delivery rates. We then consider these activities collectively to qualitatively estimate an overall sediment delivery rate.

A key factor in this assessment is the amount of land proposed for management under the HCP. If the changes could potentially result in adverse effects to salmonids, the ownership patterns in the affected watersheds are examined to help gage the scope and severity of effects. Figure 1 in the *Description of the Proposed Action* section of this Opinion provided an overview of the ownership patterns across the action area.

3) *How are the responses of those physical and biologic processes likely to affect the quality, quantity, and availability of the habitat conditions for salmon in the action area?*

The conditions of the various physical and biologic processes dictate the condition of habitat in the action area. For example, sediment delivery rates are recognized as a significant influence on the form and function of stream channels (e.g., Nelson 1998, Tripp and Poulin *op cit.* Nelson 1998). The channel form, in turn, dictates the quantity and quality of various habitat types that salmonids depend on for various life history stages. Thus, understanding changes in sediment delivery from question #2 above is critical to understanding the response of various in-stream habitat types to the proposed action.

Since many habitat responses are dependent on the interactions of more than one process (e.g., sediment and woody debris interactions), we describe the effects on habitat in the *Integration and Synthesis* section. For example, quantities of coarse sediment and LWD are thought to be factors responsible for adequate habitat conditions (Nelson 1998), and, more specifically, rearing conditions (Beechie et al. 1994) in the Skagit River Watershed in Washington state. Thus, the *Effects of the Action* section describes anticipated responses for individual watershed processes from the proposed action and the *Integration and Synthesis* section considers these responses in tandem with other factors affecting the covered species and their habitats.

A key component in this assessment is the quality, quantity and availability of existing habitat as described in the *Environmental Baseline* section. This forms a reference point to which the responses of the various physical and biologic processes are added to the environmental baseline. This reference point enables us to estimate the magnitude and direction of habitat changes, if any, as a result of the proposed action. For example, if existing baseline conditions are good and provide functional habitat, and the proposed action resulted in habitat improvements, then we would assume that conditions would remain functional under the proposed action. If, on the other hand, baseline habitat conditions are poor and limiting one or more salmonid life stages, any improvements in habitat would have to be further examined to determine whether the response of a given process under the proposed action results in poor habitat conditions or if the response is sufficient to lead towards the promotion of functional habitat.

4) *What threatened or endangered species of Pacific salmon are likely to be exposed to those changes in the quality, quantity, and availability of their habitat conditions?*

Depending on the location, all three salmonid species described in the *Status of the Species* section may be exposed to any changes in habitat quality, quantity, and availability. All three salmonid species proposed for incidental take authorization are known to occur within the action area and utilize habitat for one or more life history stages. Thus, all three salmonid species will be exposed to the effects of the action at some point during implementation of the proposed HCP.

We also recognize that salmonids in the action area are influenced by anthropogenic disturbances that do not readily fit into the above habitat process categories and these disturbances are not necessarily habitat-related. These effects are related primarily to instream equipment use associated with road-related activities and have the potential to result in injury or mortality of salmonids.

5) *How are the different life stages of those salmon likely to respond to the resulting habitat conditions, expressed in terms of the fitness (specifically, the growth, survival, and lifetime reproductive success) of these salmon?*

Given the habitat conditions resulting from the proposed action (question #3), and the distribution of Pacific salmon in the action area (question #4), we compare these expected habitat conditions with life-stage specific requirements for salmonids. In conducting our assessment of habitat responses, we use the best scientific and commercial data available to determine what constitutes functional habitat for various life stages of the species. We determine whether the habitat conditions resulting from the proposed action would reduce or improve growth, survival, or reproductive success of the exposed individuals. If the resulting habitat conditions fall short of life-stage specific requirements over the duration of the action, we assume that the growth, survival or reproductive success of individuals would be negatively impacted by the proposed action.

The habitat assessment focuses on the following life history stages: egg incubation and emergence, juvenile rearing and out-migration, and adult migration and spawning. Most importantly, we consider the effects on life history stages that may be limited by one or more habitat elements. For example, the *Environmental Baseline* section describes many areas where excessive water withdrawals have resulted in limited habitat access conditions and instances of juvenile stranding. Under these conditions, juvenile abundance is currently limited for species that depend on adequate flow regimes for successful rearing and migration, such as juvenile SONCC coho salmon.

6) *What are the probable consequences of any changes in the fitness of these salmon on the viability of the populations those salmon represent?*

This analytical approach assumes that these species, in general, will experience demographic changes (that is, changes in population size, and distribution) commensurate with the changes in the habitat-related variables described above. We note that localized impacts to habitat will not always have a measurable effect on numbers, reproduction or distribution for species that are limited in abundance or distribution in a given area. The affected individuals may be able to locate nearby suitable unoccupied habitat. However, individual salmonids in the action area are highly mobile and rely on key refugia habitat as conditions seasonally deteriorate in other areas of the action area. In particular, poor water quality conditions in the mainstem Klamath River highlight the importance of tributary reaches for seasonal rearing. Thus, we expect that effects to individual fish are likely to have an effect at the population scale, given the propensity for fish to utilize multiple areas across the action area. As a result, these habitat-related variables are used as surrogates or indices of potential population trends for the purposes of this assessment.

If the proposed action impairs the survival of an individual to its next life history stage, and depending upon the number of individuals affected, these affects may result in an adverse population response (e.g., reduction in adult spawners). These effects are taken into consideration along with existing limiting factors across the action area. These effects may negatively influence the viability of populations in the action area, depending on the magnitude of habitat responses described in question #3 and the current conditions as described in both the

*Status of the Species* and *Environmental Baseline* sections. Conversely, if the proposed action does not impair survival rates to the next life history stage, or if the impairment occurs for a life history stage that is not currently limited, we assume that the viability of populations in the action area will not be impacted by the proposed action.

7) *What are the probable consequences of any changes in the viability of those salmon populations on the viability of the salmon species themselves?*

In this final step, we consider the role of the populations in the action area to the overall survival and recovery of the affected diversity stratum (in the case of SONCC coho salmon) and the larger ESUs. If the viability of one or more of these populations is impacted by the proposed action, and these populations play an influential role in the survival and recovery of the ESU as a whole, we conclude that the proposed action would have impacts on the viability of the entire ESU. At least for coho salmon, where more work on historic population structure (*i.e.*, Williams et al. 2006) has been completed, the two watershed areas encompassed by the action area functioned as Independent Populations and their inland occurrence represents a key component in the diversity of the SONCC coho salmon ESU.

To determine if the proposed permitted activities are likely to result in the destruction or adverse modification of designated critical habitat for SONCC coho salmon, NMFS will analyze the effects of the action on the constituent elements of critical habitat identified as essential to the conservation of the species. This analysis starts the same as the jeopardy analysis described above. That is, using the best scientific and commercial data available, we estimate the responses of watershed processes as they may influence substrate and sediment levels, water quality conditions, flow, stream temperatures, physical habitat elements, channel condition, chemicals and nutrients, riparian vegetation, habitat accessibility, and the general condition of watersheds that support the biological and ecological requirements of the species. If the effects of the proposed action, when combined with the cumulative effects and environmental baseline, do not destroy or adversely modify the value of constituent elements essential to the conservation of SONCC coho salmon in the action area, then the adverse modification or destruction threshold is not reached. Conversely, if the conservation value of the affected primary constituent elements in the action area is destroyed or adversely modified, NMFS must then determine whether the impacts result in an appreciable diminishment of the value of the overall critical habitat designation for the conservation of the species. Many activities can take place within designated critical habitat without diminishing the value of constituent elements for the species' conservation. On the other hand, the adverse modification threshold may be reached when the proposed action will diminish the constituent elements in a manner likely to appreciably diminish or preclude the role of those habitat elements in the conservation of the species.

## 3.4 Characterization of the Environmental Baseline

ESA regulations define the environmental baseline as "the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process" (50 CFR 402.02). The "effects of the action" include the direct and indirect effects of the proposed action and of interrelated or interdependent activities, “that will be added to the environmental baseline” (50 CFR 402.02). Implicit in both these definitions is a need to anticipate future effects, including the future component of the environmental baseline. Future effects of federal projects that have undergone consultation and of contemporaneous state and private actions, as well as future changes due to natural processes, are part of the future baseline, to which effects of the proposed project are added.

In *National Wildlife Federation v. National Marine Fisheries Service*, 524 F.3d 917, 930-31 (9th Cir. 2008), a case regarding consultation on the effects of operating hydropower dams on the Columbia River, the 9th Circuit Court of Appeals rejected NMFS’ attempt to narrow the “effects of the action” by defining the baseline to include operations that NMFS deemed to be “nondiscretionary.” The Court observed that many of the actions NMFS deemed “nondiscretionary” actually were subject to the action agencies’ discretion, and it held that it was impermissible to create an imaginary “reference operation” excluding these actions, to which the effects of the action could be compared. Rather, the Court said that the regulatory requirement to consider the effects of the action added to the environmental baseline “simply requires NMFS to consider the effects of [the] actions ‘within the context of other existing human activities that impact the listed species.’ [citations omitted]” *Id.* at 930. In other words, the effects of a particular federal action are intended to be evaluated not simply on their own, but as they affect the species in combination with other processes and activities.

The question addressed in a consultation is whether the *project* jeopardizes the species’ continued existence. As the court stated in *National Wildlife Federation*, even if the baseline itself causes jeopardy to the species, only if the project causes additional harm can the project be found to jeopardize the species’ continued existence. *Id.* This determination requires an evaluation of the *project’s* effects, separate from the conditions that would exist if the project were not carried out.

In this Opinion, we summarize in the *Environmental Baseline* section the past and present impacts leading to the current status of the species in the action area, including the effects of FGS’s operations in the past. Also in the *Environmental Baseline* section, we describe the future non-project stressors to which the listed species and their critical habitats will be exposed.

### 3.5 Data Available for the Analysis

To conduct our analysis, we consider many lines of data available through published and unpublished sources that represent evidence of adverse consequences or the absence of such consequences. The following provides a list of resources that we considered:

- Final rule listing SONCC coho as threatened (70 FR 37160)
- Final rule designating critical habitat for SONCC coho (64 FR 24049)
- Final rule determining threatened or endangered status for KMP steelhead is not warranted (66 FR 17845)
- Final rule determining threatened or endangered status for Klamath and Trinity Rivers Chinook is not warranted (63 FR 11482)
- Final Fruit Growers Supply Company Multi-Species Habitat Conservation Plan
- First Administrative Final Environmental Impact Statement (FEIS) for Authorization for Incidental Take and Implementation of Fruitgrowers Supply Company Multi-

Species Habitat Conservation Plan, dated December, 2010

- Previously issued NMFS biological opinions; and

- NMFS Southwest Fisheries Science Center reviews (e.g., ocean productivity, declarations, climate change).

The primary source of initial project-related information was the proposed HCP/Draft Final EIS. Included with the proposed HCP/Draft Final EIS was an extensive bibliography that served as a valuable resource for identifying important references and data sources on the resource conditions within the action area.

As discussed above, this Opinion equates a listed species' probability or risk of extinction with the likelihood of both the survival and recovery of the species, and uses "likelihood of viability" as a standard to bridge between the VSP framework (McElhany et al. 2000) and the jeopardy standard. Assessing the viability of salmonid populations requires the consideration of other parameters in addition to population abundance, including productivity (*i.e*., population growth rate), spatial structure, and genetic and life-history diversity (McElhany et al. 2000). All four VSP parameters are deemed important in evaluating a population's ability to persist, especially when faced with catastrophic disturbances (Lindley et al. 2007). Although the life-cycle impact approaches discussed previously have the potential to provide information on all VSP parameters at some point in the future, it would require substantial data collection and potentially life-cycle impact modeling. Any present attempt to complete such an exercise would only address one of those parameters (*i.e*., abundance), and any results would include making many assumptions. Therefore, although a method for evaluating impacts during a specific life stage in terms of the overall loss in numbers of fish would be useful, there are other potential consequences resulting from the proposed HCP that need to be considered. For example, are mortalities at different life stages, or the loss of historical habitats, likely to have effects on the other VSP parameters? The analyses within this Opinion, in an attempt to encompass this broader range of effects, focused on determining whether or not appreciable reductions were expected from the proposed action, rather than trying to quantify the absolute magnitude of those reductions.

### 3.5.1 Critical Assumptions in the Analysis

To address the uncertainties identified related to the proposed action and the analysis provided in the proposed HCP/Draft Final EIS, NMFS established a set of key assumptions we would need to make to bridge the existing data gaps in the proposed HCP/Draft Final EIS that are critical to our analysis of effects. Table 5 provides the general assumptions that we made in filling those data gaps.

**Table 5. General Assumptions of the Proposed Action**

| Assumption | Basis |
|---|---|
| FGS, or its successors, will remain a viable business for the next 50 years and is able to fully implement mitigation and conservation measures outlined in the HCP. | FGS has been in business for more than 100 years and has a track record of sound fiscal management. |
| With proper implementation of HCP conservation measures, rates of sediment delivery to watersheds within the HCP area will decline during the 50-year permit term. | Similarly situated commercial timber HCPs and other conservation plans which address watershed sediment sources have shown declining rates in sediment delivery with implementation of similar conservation measures (HRC, 2010). |
| Rates of vegetative growth and stream canopy in Class I and II riparian areas within the HCP area will increase during the 50-year permit term with proper implementation of riparian management measures. | Improvements in forest practices provide for better management of riparian zones with the understanding that late-seral conditions provide high value salmonid habitat (e.g., practices such as "thin from below" and increasing quadratic mean diameter of trees post-harvest) |
| With proper implementation of HCP harvest restrictions, characteristics (volume, timing, intensity, etc.) of surface runoff from the HCP area will remain similar to baseline conditions or improve baseline conditions throughout the duration of the 50-year permit term | Over the last 35 years or so, methods of timber harvest in California have continually improved so that ground disturbing activities have lessened, resulting in reductions of surface runoff from harvest activities (e.g., application of mulch on bare soil areas). Even with improvements in forestry practices however, NMFS believes harm to habitat is still occurring, and individually or cumulatively contributes to incidental take of listed salmonids. |
| Stream channel conditions within the action area improve over the 50-year permit term with proper implementation of HCP management and mitigation measures (e.g., increase in LWD levels, reduction in fine sediment levels, improvement in pool formation and depths) | In general, stream channel conditions respond positively to reductions in disturbances to riparian areas as well as upslope processes. Actions that reduce rates of landsliding, surface erosion, and removal of riparian trees, will result in development of channel conditions more suitable for salmonid production. |

## 3.6 **Integrating the Effects**

Through our integration and synthesis of the stressors affecting covered species and the habitats upon which they depend, we must determine if the proposed action is not likely to appreciably reduce the likelihood of both the survival and recovery of the species and not likely to result in the destruction or adverse modification of critical habitat. In summary, the combined effects analysis and biological jeopardy determination is made in the following manner:

> The effects of the proposed Federal action, in this case approval of the ITP with resulting implementation of the HCP, are evaluated in the context of the aggregate effects of all factors that have contributed to the covered species' current status and, for federal and non-Federal activities in the action area, those future actions likely to affect the three salmonids, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the three

salmonids in the wild. Inherent in this analysis is an understanding of how actions in the past within the action area have affected the three covered species, how future actions are anticipated to effect the species, and finally, how the proposed action can add to further effects on the species (either adversely or beneficially).

# 4 STATUS OF THE SPECIES AND CRITICAL HABITAT

Table 6 lists the listed and unlisted species (together, protected species) and designated critical habitats addressed in this document that occur in the action area and may be affected by the proposed action (issuance of the ITP and implementation of the HCP):

**Table 6. Protected Species and Designated Critical Habitat Within the Action Area**

| Evolutionarily Significant Unit (ESU) | Scientific Name | Listing Status | Federal Register Notice | Geographic Distribution | Critical Habitat Designation |
|---|---|---|---|---|---|
| SONCC coho salmon | *Oncorhynchus kisutch* | threatened | June 20, 2005 (70 FR 37160) | From Cape Blanco Oregon, to Punta Gorda, California | May 5, 1999 (64 FR 24049) |
| Klamath Mtn. Province Steelhead | *O. mykiss* | not warranted | April 4, 2001 (66 FR 17845) | From Elk River in Oregon through the Klamath and Trinity Rivers | N/A |
| Upper Klamath and Trinity Rivers Chinook | *O. tshawytcha* | not warranted | March 9, 1998 (63 FR 11482) | All watersheds upstream from the Klamath-Trinity confluence | N/A |

Within the action area, more specific population viability information is provided in the *Environmental Baseline* discussion for each watershed in the action area analyzed.

## 4.1 SONCC Coho Salmon

The effects of the proposed action will not be further considered in this Opinion for the Shasta River population of SONCC coho salmon. FGS' operations likely have little impact on this population of coho or their critical habitat in this watershed. Individuals of the Shasta River coho population migrate through the mainstem Klamath River corridor downstream of FGS lands for approximately 20 miles, but exposure to stressors caused by implementation of the HCP are likely to be insignificant to individuals (e.g. exposure to a sediment plume for a short duration). Therefore, we have determined that the Shasta River population of coho salmon will not be adversely affected by the proposed action. Similarly, we do not anticipate SONCC coho critical habitat located in the Shasta River will be adversely affected by the proposed action.

### 4.1.1 General Life History

Adult coho salmon reach sexual maturity at 3 years, and die after spawning. Precocious 2 year olds, especially males, also make up a small percentage of the spawning population. Coho salmon adults migrate and spawn in small streams that flow directly into the ocean, or tributaries and headwater creeks of larger rivers (Sandercock 1991, Moyle 2002). Adults migrate upstream to spawning grounds from September through late December, peaking in October and

November.  Adult coho salmon migrate at water temperatures of 45 to 59º F, a minimum water depth of approximately 7 inches, and streamflow velocities less than 8 ft/s (Bjornn and Reiser 1991).  Coho salmon are known to stage at the confluences of tributaries, holding until flows and temperatures are suitable for migration into upper tributary spawning habitat.  Spawning occurs mainly in November and December, with fry emerging from the gravel in the spring, approximately 3 to 4 months after spawning.  The favorable range for coho salmon egg incubation is 10-13.5ºC (Bell 1991).  Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although they may move up to streams of 4 percent or 5 percent gradient.  Juveniles have been found in streams as small as 1 to 2 meters wide.  They may spend 1 to 2 years rearing in freshwater (Bell and Duffy 2007), or emigrate to an estuary shortly after emerging from spawning gravels (Tschaplinski 1988).  Coho salmon juveniles are also known to "redistribute" into non-natal rearing streams, lakes, or ponds, often following rainstorms, where they continue to rear (Peterson 1982).  At a length of 38 to 45 mm, fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Godfrey 1965 *op. cit.* Sandercock 1991, Nickelson et al. 1992).  Emigration from streams to the estuary and ocean generally takes place from March through May.

### 4.1.2 Range-Wide (ESU) Status and Trends

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

The main populations in the SONCC coho salmon ESU (Rogue, Klamath, and Trinity Rivers) remain heavily influenced by hatcheries and have little natural production in mainstem rivers (Weitkamp et al. 1995, Good et al. 2005).  The listing of SONCC coho salmon includes all hatchery-produced coho salmon in the ESU range (70 FR 37160).  Trinity River Hatchery maintains high production rates, with straying of hatchery reared SONCC coho salmon into non-natal streams occurring regularly (NMFS 2001a).  The Mad River Hatchery ceased coho salmon production in 1999 and Iron Gate Hatchery, located in the Klamath River, has reduced production in recent years to a production goal of 75,000 juveniles (FERC 2007).  The apparent decline in wild production in these rivers, in conjunction with significant hatchery production, suggests that natural populations of coho salmon are not self-sustaining (Weitkamp et al. 1995, Good et al. 2005). Coho salmon populations continue to be depressed relative to historical numbers, and there are strong indications that breeding groups have been lost from a significant percentage of streams within their historical range (Good et al. 2005).

Combining California run-size estimates with Rogue River estimates, Weitkamp et al. (1995) arrived at a rough minimum run-size estimate for the SONCC coho salmon ESU of about 10,000 natural fish and 20,000 hatchery fish. Brown and Moyle (1991) suggested that naturally-spawned adult coho salmon runs in California streams were less than one percent of their abundance at mid-century, and estimated that wild coho salmon populations in California did not exceed 100 to 1,300 individuals. CDFG (1994) summarized most information for the northern California portion of this ESU, and concluded that "coho salmon in California, including hatchery stocks, could be less than 6 percent of their abundance during the 1940s, and have experienced at least a 70 percent decline in numbers since the 1960's." Further, CDFG (1994) reported that coho salmon populations have been virtually eliminated in many streams, and that adults are observed only every third year in some streams, suggesting that two of three brood cycles may have already been eliminated.

Scientists at NMFS' Southwest Fisheries Science Center compiled a presence-absence database for the SONCC coho salmon ESU similar to that developed by CDFG (Good et al. 2005). The data set includes information for coho salmon streams listed in Brown and Moyle (1991), as well as other streams that NMFS found historical or recent evidence of coho salmon presence. The database is a composite of information contained in the NMFS (2001) status review update, additional information gathered by NMFS since publication of the 2001 status review, data used in the CDFG (2002) analysis, and additional data compiled by CDFG for streams not on the Brown and Moyle (1991) list. Using the NMFS database, Good et al. (2005) compiled information on the presence of coho salmon in streams throughout the SONCC ESU (Figure 5), which closely matched the results of Brown and Moyle (1991).

Annually, the estimated percentage of streams in the SONCC coho salmon ESU for which coho salmon presence was detected generally fluctuated between 36 percent and 61 percent between brood years 1986 and 2000 (Figure 5). Data reported for the 2001 brood year suggest a strong year class, as indicated by an occupancy rate of more than 75 percent; however, the number of streams for which data were reported is small compared to previous years making conclusions from this data set difficult. The data suggest that, for the period of record, occupancy rates in the SONCC coho salmon ESU were highest (54 to 61 percent) between brood years 1991 and 1997, then declined between 1998 and 2000 (39 to 51 percent) before rebounding in 2001. However, the number of streams surveyed in 2001 was roughly 25 percent of the number surveyed in previous years (Good et al. 2005). For a discussion of the current viability of the SONCC coho salmon ESU, please see the *Viability of the ESU/DPS* section of this document.

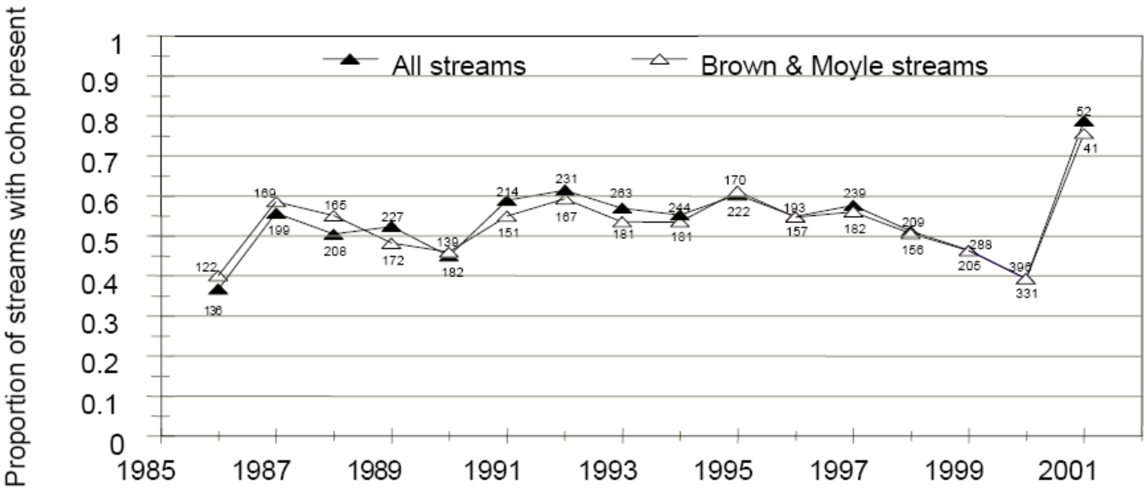


Figure 5. Proportion of surveyed streams with coho salmon present (from Good et al. 2005). The number of streams surveyed noted with each data point.

### 4.1.3 Current Viability of the SONCC ESU and Extinction Risk

*Viability of the ESU*

One prerequisite for predicting the effects of a proposed action on a species is understanding the likelihood of the species in question becoming viable, and whether the proposed action would be expected to reduce this likelihood.

The SONCC ESU comprises many multiple individual populations within a specific geographic area. For SONCC this includes populations found in coastal watersheds from the Elk River (Oregon) south to the Mattole River (California). Williams et al. (2008) reiterated that salmonid species have a tiered population structure based on the potential of exchange of individuals between similar components. For example, a range starts with a sub-population (a breeding group), to dependent populations, to independent populations, to population groups (e.g., diversity strata), and terminates with the ESU (Bjorkstedt et al. 2005, Lawson et al. 2007). In general, independent populations are critically important to maintaining an overall viable ESU.

McElhany et al. (2000) defined an independent population as "any collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year time period are not substantially altered by exchanges of individuals with other populations." For example, Williams et al. (2008) lists Humboldt Bay tributaries as a functionally independent population, even though this unit contains separate sub-populations from major watersheds which all terminate in Humboldt Bay. These tributaries and Humboldt Bay consist of a collection of local breeding units that are unlikely to exchange significant individuals with other populations, like the Mad River functionally independent population to the north. Bringing in the definition of a viable salmonid population above, the Humboldt Bay tributaries functionally independent population will not be considered viable unless it has negligible risk of extinction from the threats identified over a 100-year time frame.

To integrate population information into viability criteria at the ESU or DPS scale, NMFS has identified "diversity strata", which are "groups of populations that span the diversity and distribution that currently exists or historically existed within an ESU" (Bjorkstedt et al. 2005). Diversity strata account for the important variability that exists in environments and in the physical characteristics and genetic makeup of salmonids. Bjorkstedt et al. (2005) and Williams et al. (2006) provide a set of rules that are expected to result in certain configurations of populations within each diversity stratum that they believe will result in a viable ESU. A population, either independent or dependent, is part of a particular diversity stratum, which is part of a particular ESU or DPS. At a large-scale view, a diversity stratum could be considered viable even if one or more of its component populations were not viable, if the remaining populations met all the viability characteristics including, abundance, productivity, diversity, and spatial structure (McElhany et al. 2000, Bjorkstedt et al. 2005, Williams et al. 2006). Williams et al. (2008) further states that, "A viable ESU comprises sets of viable (and sometimes non-viable) populations that, by virtue of their size and spatial arrangement, result in a high probability of persistence over the long term."

The abundance of spawners is just one of several criteria that must be met for a population to be considered viable. McElhany et al. (2000) acknowledged that a viable salmonid population at the ESU scale is not merely a quantitative number that needs to be attained. Rather, for an ESU to persist, populations within the ESU must be able to spread risk and maximize future potential for adaptation.

Williams et al. (2008) summarizes that there are "insufficient data to assess the risk to coho populations within the SONCC ESU, and therefore, we cannot assess the viability of the ESU using the quantitative approach…" In order to fully assess extinction risk, a population viability analysis (PVA) may be conducted which can estimate the probability of population extinction or collapse within a given time period (Beissinger and McCullough 2002). Data needed for a PVA include current population abundance, intrinsic population growth rate, habitat capacity, and variation in fecundity, growth, or survival (Belovsky 1987, Lande 1993). Such quantitative efforts require extensive data, which unfortunately, is lacking for much of the SONCC ESU.

*SONCC Population Size, Productivity, Spatial Structure, and Diversity*

The following provides the evaluation of the likelihood of SONCC coho ESU being determined viable based on the VSP parameters of population size, population growth rate, spatial structure, and diversity. These specific parameters are important components in the evaluation of extinction risk even without a PVA, and the parameters reflect general biological and ecological processes that are critical to the growth and survival of salmon (McElhany et al. 2000).

*Population Size*

Information about population size provides an indication of the sort of extinction risk that a population faces. For instance, in most cases smaller populations are at a greater risk of extinction than large populations because the processes that affect populations operate differently in small populations than in large populations (McElhany et al. 2000). One risk of low population sizes is depensation. Depensation occurs when populations are reduced to very low densities and per capita growth rates decrease as a result of a variety of mechanisms [*e.g.*, failure to find mates and therefore reduced probability of fertilization, failure to saturate predator populations (Liermann and Hilborn 2001)]. Depensation results in a negative feedback trend that accelerates a decline toward extinction (Williams et al. 2007).

The final rule for the ESA listing of the California Coastal Chinook ESU (June 28, 2005, 70 FR 37160) stated "an assessment of the effects of [multiple] small artificial propagation programs on the viability of the ESU in-total concluded that they collectively decrease risk to some degrees by contributing to local increases in abundance . . ." However, McElhany et al. (2000) cautioned, "note that the ESA's primary focus is on natural populations in their native ecosystems, so when we evaluate abundance to help determine VSP status, it is essential to focus on naturally produced fish (*i.e*., the progeny of naturally-spawning parents)." Based on these guidance documents, to the extent that hatchery-reared parents may boost production of naturally produced fish if and when they spawn in the wild, they may benefit the VSP parameter of population size. However, a population cannot be considered viable unless it has the minimum number of *naturally produced* spawners identified in recent guidance documents (Spence et al. 2008; Williams et al. 2007, 2008). Although the operation of a hatchery tends to increase the abundance of returning adults (70 FR 37160), the reproductive success of hatchery-born salmonids spawning in the wild is far less than that of naturally produced ones (Araki et al. 2007). As a result, the higher the proportion of hatchery-born spawners, the lower the productivity of the population, as demonstrated by Chilcote (2003). Chilcote (2003) examined the actual number of spawners and subsequent recruits over 23 years in 12 populations of Oregon steelhead with varying proportions of hatchery-origin spawners and determined ". . . a spawning population comprised of equal numbers of hatchery and wild fish would produce 63 percent fewer recruits per spawner than one comprised entirely of wild fish." In short, naturally produced spawners are better at producing naturally reproducing progeny, which in turn, sustains wild populations.

In order for the SONCC coho salmon ESU to be viable, each of the diversity strata needs to be viable. Second, in order for a diversity stratum to be viable, at least two, or 50 percent of the independent populations (Functionally Independent or Potentially Independent), whichever is greater, must be viable, and the abundance of these viable independent populations collectively must meet or exceed 50 percent of the abundance predicted within the diversity stratum when it is at low risk of extinction. Table 7 is taken from Williams et al. (2008) and gives the depensation thresholds and low risk spawner thresholds for independent populations throughout the ESU. Achievement of the low risk spawner threshold essentially means that population is no longer at risk of extirpation. Third, all dependent and independent populations not expected to meet the low-risk threshold within a diversity stratum must exhibit occupancy patterns that indicate sufficient immigration is occurring from the "core populations." Finally, the distribution of extant populations, both dependent and independent, needs to maintain connectivity within and among diversity strata. Status reviews for the SONCC coho salmon ESU, concluded data were insufficient to set specific numeric population size targets for viability (Williams et al. 2008). In the absence of such targets, McElhany et al. (2000) suggested ESUs ". . . have been historically self-sustaining and the historical number and distribution of populations serves as a useful 'default' goal in maintaining viable ESUs."

**Table 7. Specific viability criteria for independent populations of coho salmon in the SONCC ESU (from Williams et al. 2008).**

| Population Unit | Historical IP km | Depensation threshold (fish) | Spawner density (fish/IP km) | Spawner threshold low risk |
|---|---|---|---|---|
| Elk River (1) | 62.64 | 63 | 38 | 2,400 |
| Lower Rogue River (7a) | 80.88 | 81 | 37 | 3,000 |
| Illinois River (7b) | 589.69 | 590 | 20 | 11,800 |
| Mid. Rogue/Applegate Rivers (7c) | 758.58 | 759 | 20 | 15,200 |
| Upper Rogue River (7d) | 915.43 | 915 | 20 | 18,300 |
| Chetco River (10) | 135.19 | 135 | 33 | 4,500 |
| Winchuck River (11) | 56.5 | 57 | 39 | 2,200 |
| Smith River (12) | 385.71 | 386 | 20 | 7,700 |
| Lower Klamath River (15a) | 204.69 | 205 | 29 | 5,900 |
| Middle Klamath River (15b) | 113.49 | 113 | 34 | 3,900 |
| Upper Klamath River (15c) | 424.71 | 425 | 20 | 8,500 |
| Salmon River (15d) | 114.8 | 115 | 35 | 4,000 |
| Scott River (15e) | 440.87 | 441 | 20 | 8,800 |
| Shasta River (15f) | 531.01 | 531 | 20 | 10,600 |
| South Fork Trinity River (15g) | 241.83 | 242 | 26 | 6,400 |
| Lower Trinity River (15h) | 112.01 | 112 | 35 | 3,900 |
| Upper Trinity River (15i)_ | 64.33 | 64 | 37 | 2,400 |
| Redwood Creek (16) | 151.02 | 151 | 32 | 4,900 |
| Maple Creek/Big Lagoon (18) | 41.3 | 41 | 39 | 1,600 |
| Little River (19) | 34.2 | 34 | 41 | 1,400 |
| Mad River (22) | 152.87 | 153 | 32 | 4,900 |
| Humboldt Bay tributaries (23) | 190.91 | 191 | 30 | 5,700 |
| Lower Eel/ Van Duzen Rivers (24a) | 393.52 | 394 | 20 | 7,900 |
| South Fork Eel River (24b) | 476.1 | 476 | 20 | 9,500 |
| Mainstem Eel River (24c) | 143.9 | 144 | 33 | 4,700 |
| North Fork Eel River (24d) | 53.97 | 54 | 39 | 2,100 |
| Middle Fork Eel River (24e) | 77.7 | 78 | 37 | 2,900 |
| Middle Mainstem Eel River (24f) | 255.5 | 256 | 25 | 6,500 |
| Upper Mainstem Eel River (24g) | 54.11 | 54 | 39 | 2,100 |
| Bear River (26) | 47.84 | 48 | 40 | 1,900 |
| Mattole River (28) | 249.79 | 250 | 26 | 6,500 |
| | | | | |

*Population Productivity*
NMFS has determined the SONCC ESU suffers from impaired productivity levels which contribute significantly to a long-term risk of extinction. Productivity does not appear sufficient to maintain viable abundances in many of the ESU independent populations. As such, NMFS has determined that this ESU is not viable in regards to the population productivity VSP parameter (Good et al. 2005).

*Spatial Structure*
Relatively low levels of observed presence in historically occupied coho salmon streams (32 to 56 percent from 1986 to 2000; and 54 to 61 percent between 1991 and 1997) indicate continued low abundance in the California portion of the SONCC coho salmon ESU compared to historic levels. Brown et al. (1994) found survey information on 115 streams within the SONCC coho salmon ESU, of which 73 (64 percent) still supported coho salmon runs while 42 (36 percent) did not. The streams Brown et al. (1994) identified as presently lacking coho salmon runs were all tributaries of the Klamath River and Eel River systems. The BRT was also concerned about the loss of local populations in the Trinity, Klamath, and Rogue River basins (June 28, 2005, 70 FR 37160). CDFG (2002) reported a decline in SONCC coho salmon occupancy, with the percent reduction dependent on the data sets used. Although there is considerable year-to-year variation in estimated occupancy rates, it appears that there has been no dramatic change in the percent of coho salmon streams occupied from the late 1980s and early 1990s to 2000 (Good et al. 2005) indicating the spatial distribution of SONCC coho relatively stable even if significantly reduced over the last 50 years. In summary, recent information for SONCC coho salmon indicates that their distribution within the ESU has been reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which they are now absent (NMFS 2001a). However, extant populations can still be found in all major river basins within the ESU (June 28, 2005, 70 FR 37160). Figure 6 gives the diversity strata for SONCC coho as proposed in Williams et al. (2006).

NMFS has determined that declines in spatial structure and connectivity for this ESU contributes significantly to long-term risk of extinction but does not in itself constitute a danger of extinction in the near future. As the ‘default’ historic spatial processes described by McElhany et al. (2000) have likely not been preserved, due to the habitat fragmentation described above, NMFS concludes this ESU is not viable in regards to the spatial structure VSP parameter. (Good et al. 2005)

*Diversity*
Genetic variability is important because, in general, differing genetic traits favor a population being able to survive and reproduce under changing environmental conditions. With regard to the SONCC coho salmon ESU, human activities (including construction of migration barriers, e.g., Iron Gate Dam on the Klamath River and Lewiston Dam on the Trinity River) have eliminated portions of some coho salmon populations from the ESU. In addition, runs of coho salmon within the Klamath River basin are now composed largely of hatchery fish from Iron Gate and Trinity River Hatcheries.

The high hatchery production in some systems in the SONCC coho salmon ESU may mask trends in ESU population structure and pose risks to ESU diversity (70 FR 37160). NMFS determined that the Cole River Hatchery, Trinity River Hatchery, and Iron Gate Hatchery coho salmon hatchery programs are part of the ESU, and that these artificially propagated stocks are no more divergent relative to the local natural populations than what would be expected between closely related natural populations within the ESU (70 FR 37160). In 2010, a total of 3,868 adult coho returned to Trinity River Hatchery and 428 adult coho returned to Iron Gate Hatchery. The goal for returns to the hatcheries is 2,000 adults (PFMC 2011a). Within 10 historical populations that have dams blocking upstream access, 26.4 percent of historical habitat is currently located upstream of the dams (Table 5 in Williams et al. 2007). This loss of or limitations on spawning and rearing opportunities is expected to adversely affect the species' basic demographic and evolutionary processes (e.g., population interchange), causing a reduced potential that the ESU can withstand environmental fluctuations; thus, activities that negatively affect evolutionary processes (e.g., natural selection) have the potential to alter the diversity of the species.

The primary factors affecting the diversity of SONCC coho salmon appear to be the influence of hatcheries and out-of-basin introductions. In addition, some brood years have abnormally low abundance levels or may even be absent in some areas (e.g., Shasta River and Scott River in the Northern Interior Diversity Stratum), further restricting the diversity present in the ESU. NMFS' evaluation of diversity within the ESU concludes that the current genetic variability and variation in life history factors contribute significantly to long-term risk of extinction but do not, in themselves, constitute a danger of extinction in the near future (Good et al. 2005). NMFS concludes the current phenotypic diversity in this ESU is much reduced compared to historic levels, so by McElhany's criteria it is not viable in regards to the diversity VSP parameter.

*Viability Summary*

NMFS recently completed a status review for SONCC coho and determined that although short-term research and monitoring indicates that abundance of coho salmon has decreased for many populations in the SONCC ESU since the last status review in 2005, the biological status of this ESU and the threats facing this ESU indicate that it continues to remain threatened and has not declined to a point where it is considered endangered (NMFS 2011b). NMFS concludes that recent available times series of population trends have been downward, notably the Shasta River population which exhibited a significant negative trend, as has the Rogue River Basin population. These negative trends NMFS has concluded are cause for concern and result in a recommendation by NMFS that the ESU and relevant environmental conditions be carefully monitored, and that the status of the ESU be reassessed in 2-3 years if it does not respond positively to improvements in environmental conditions and management actions (NMFS 2011b).

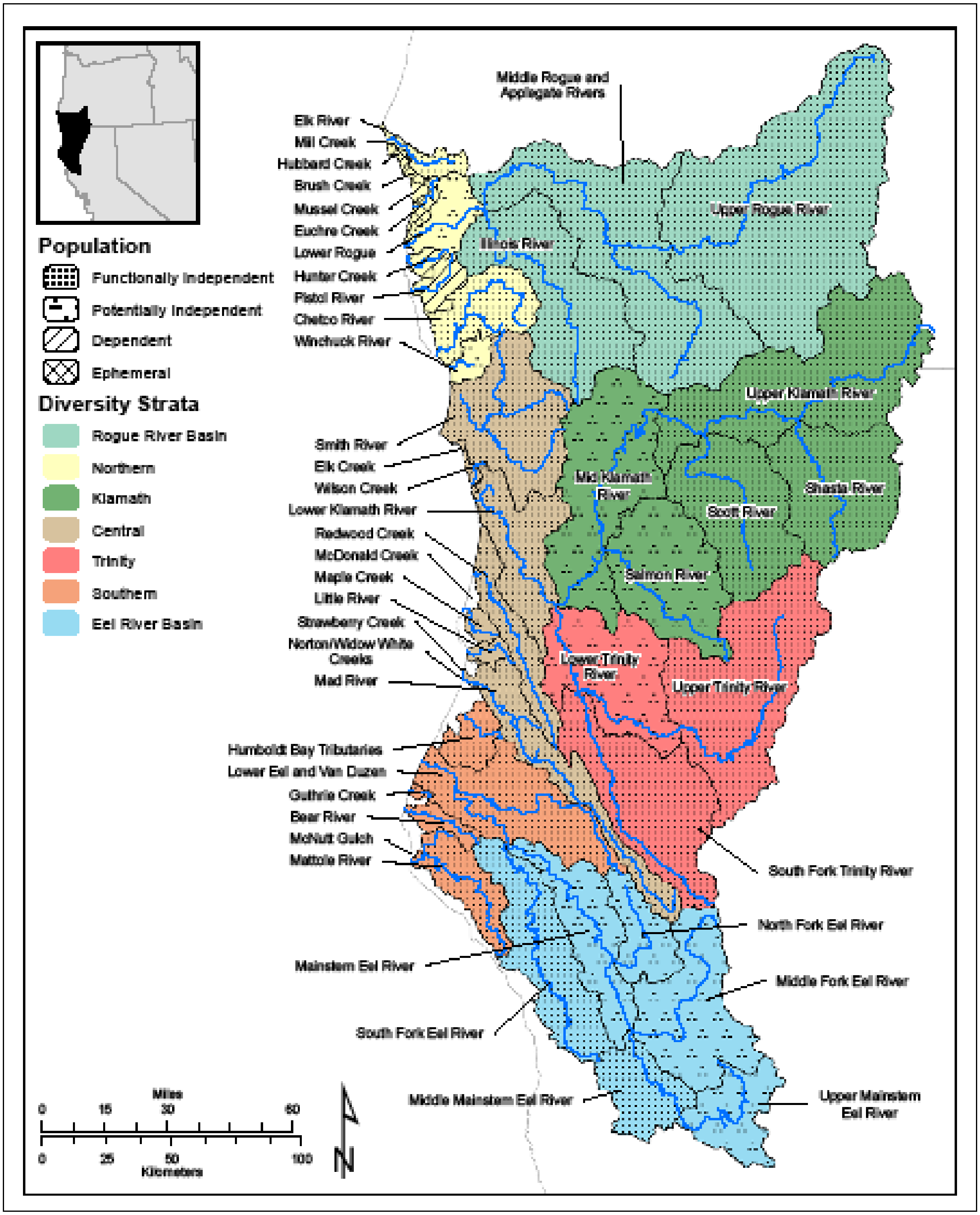


**Figure 6. Diversity strata for populations of coho salmon in the SONCC ESU (from Williams et al. 2006).**

## 4.2 SONCC Coho Salmon Critical Habitat

### 4.2.1 Status of SONCC Coho Critical Habitat

Critical habitat is defined as the specific areas within the geographical areas occupied by the species, at the time it is listed, on which are found those physical and biological features essential to the conservation of the species and which may require special management considerations or protection, and specific areas outside the geographical area occupied by the species at the time it is listed when the Secretary determines that such areas are essential for the conservation of the species.

This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. § 402.2, as it was invalidated by the 9th Circuit Court of Appeals in 2004. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

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

### 4.2.2 Description of Critical Habitat

Critical habitat for the SONCC coho salmon ESU encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between Cape Blanco, Oregon and Punta Gorda, California (64 FR 24049; May 5, 1999). NMFS further describes critical habitat as:

> Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches (including off-channel habitats) in hydrologic units and counties identified in Table 6 of this part. Accessible reaches are those within the historical range of the ESU that can still be occupied by any life stage of coho salmon. Inaccessible reaches are those above specific dams identified in Table 6 of this part or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

Excluded are: (1) areas above specific dams identified in the FR notice, (2) areas above longstanding natural impassible barriers (*i.e*., natural waterfalls in existence for at least several hundred years), and (3) tribal lands.

In designating critical habitat for SONCC coho salmon, NMFS focused on the known physical and biological features within the designated area that are essential to the conservation of the species. These essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation. Within the essential habitat types (spawning, rearing, migration corridors), essential features of coho salmon critical habitat include adequate: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions (64 FR 24049; May 5, 1999). Designated critical habitat for SONCC coho salmon overlaps the project action area.

*<u>Current Condition of Critical Habitat at the ESU Scale</u>*

Because coho salmon spend one, sometimes up to two years rearing in freshwater (Bell and Duffy 2007), they are especially susceptible to changes within the freshwater environment, more so than fall Chinook salmon for example, which migrate to the ocean shortly after emerging from spawning gravels. The condition of estuarine and freshwater habitat throughout the range of SONCC coho salmon is degraded, relative to historical conditions. While some relatively unimpaired streams exist within the ESU, decades of intensive timber harvesting, mining, agriculture, channelization, dam building, and urbanization have altered coho salmon critical habitat, sometimes to the extent that it is no longer able to support one or more of the life stages of coho salmon. A summary discussion of the conditions of the essential habitat types necessary to support the life cycle of SONCC coho (64 FR 24049; May 5, 1999) is presented below:

*Juvenile Summer and Winter Rearing Areas*

Juvenile summer and winter rearing areas should contain adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, and space. These essential features are necessary to provide sufficient growth and reasonable likelihood of survival to smoltification. In the SONCC ESU, juvenile summer rearing areas have been compromised by low flow conditions, high water temperatures, insufficient dissolved oxygen levels, excessive nutrient loads, invasive species, habitat loss, disease effects, pH fluctuations, sedimentation, removal or non-recruitment of large woody debris, stream habitat simplification, and loss of riparian vegetation. Winter rearing areas suffer from high water velocities due to excessive surface runoff during storm events, suspended sediment in the water column, removal or non-recruitment of large woody debris and stream habitat simplification. Changes to streambeds and substrate, as well as removal of riparian vegetation have limited the amount of invertebrate production in streams, which has in turn limited the amount of food available to rearing juveniles. Some streams in the ESU remain somewhat intact relative to their historical condition, but the majority of the waterways in the ESU fail to provide sufficient juvenile summer and winter rearing areas.

*Juvenile Migration Corridors*

Juvenile migration freshwater corridors need to have sufficient water quality, water quantity, water temperature, water velocity, and safe passage conditions in order for coho salmon juveniles and smolts to emigrate to estuaries and the ocean, or to redistribute into non-natal rearing zones. Adequate juvenile migration corridors need to be maintained throughout the year because smolts emigrate to estuaries and the ocean from the early spring through the late summer, while juveniles may redistribute themselves at any time in response to fall freshets or while seeking better habitat and rearing conditions. In the ESU, juvenile migration corridors suffer from low flow conditions, disease effects, high water temperatures and low water velocities that slow and hinder emigration or upstream and downstream redistribution. Low dissolved oxygen (DO) levels, excessive nutrient loads, insufficient pH levels and other water quality factors also afflict juvenile migration corridors.

*Adult Migration Corridors*
Adult migration corridors should provide satisfactory water quality, water quantity, water temperature, water velocity, cover/shelter and safe passage conditions in order for adults to reach spawning areas. Adults generally migrate in the late fall or winter months to spawning areas. Removal or non-recruitment of woody debris and stream habitat simplification limits the amount of cover and shelter available for adults to rest during high flow events. Low flows in streams can physically hinder adult migration, especially if fall rain storms are late or insufficient to raise water levels enough to ensure adequate passage. Poorly designed culverts and other road crossings have truncated adult migration corridors and cut off hundreds of miles of stream habitat throughout the SONCC coho salmon ESU. While adult migration corridors are a necessary step in the lifecycle for the species, the condition of this particular essential habitat type in the ESU is probably not as limiting, in terms of survival and recovery of the species, as other essential habitat types, such as juvenile summer and winter rearing areas. Ocean habitat is not designated as "critical habitat" for the SONCC ESU.

*Spawning Areas.*
Spawning areas for SONCC coho salmon must include adequate substrate, water quality, water quantity, water temperature, and water velocity to ensure successful redd building, egg deposition and egg-to-fry survival. Generally, coho salmon spawn in smaller tributary streams from November through January in the ESU. A widespread problem throughout the ESU is sedimentation and embedding of spawning gravels, which makes redd building for adults difficult and decreases egg-to-fry survival. Excessive runoff from storms, which causes redd scouring, is another issue that plagues adult spawning areas. Low or non-recruitment of spawning gravels via mechanisms such as dam building is common throughout the ESU, limiting the amount of spawning habitat suitable for egg deposition and emergence.

*Watershed Restoration and Improvements to Critical Habitat*
There are various restoration and recovery actions underway across the ESU aimed at improving habitat and water quality conditions for anadromous salmonids. Watershed restoration activities have improved freshwater critical habitat conditions in some areas, especially on federal lands. For instance, the CDFG created both a multi-stakeholder Coho Recovery Team to address statewide recovery issues, and a sub-working group [Shasta –Scott Recovery Team (SSRT)] to develop coho salmon recovery strategies associated specifically with agricultural management within the Scott and Shasta River valleys to return coho salmon to a level of viability. In addition, the five northern California counties affected by the federal listing of coho salmon have created a 5 County Conservation Plan that establishes continuity among the counties for managing anadromous salmonid populations (Voight and Waldvogel 2002). In 2007 NMFS approved a 4(d) rule for routine road maintenance activities in the 5 County area. In addition to the road activities, the five county plan identifies priorities for monitoring, assessment, and habitat restoration projects. As of 2008, all counties either completed or were soon to complete inventories of problems on their road systems. Between 1998 and 2007 51 migration barriers were improved throughout the 5 county area restoring access to 125 miles of habitat (Harris, 2008). The Bear Creek Watershed Council (Rogue River tributary) is developing restorative, enhancement, and rehabilitative actions targeted at addressing limiting factors for viability. Similarly, several assessments have been completed for the Oregon coast in coordination with the Oregon Watershed Enhancement Board. These plans and assessments are helping to reduce,

or stabilize, sediment inputs into streams throughout the ESU. Additionally, in areas where riparian vegetation has been replanted or enhanced, stream temperatures and cover for salmonids has been positively affected.

### 4.2.3 Conservation Value of Critical Habitat

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

*SONCC Coho Salmon Critical Habitat Summary*

The current function of critical habitat in the SONCC coho salmon ESU has been degraded relative to historical conditions. Although there are exceptions, the majority of streams and rivers in the ESU contain impaired habitat. Additionally, critical habitat in the ESU often lacks the ability to establish essential features due to ongoing human activities. For example, large dams, such as Iron Gate Dam on the Klamath River, impede sediment mobility and reduces spawning gravel recruitment in downstream reaches, which impacts both an essential habitat type (spawning areas) as well as an essential feature of spawning areas (substrate). Water utilization in many regions throughout the ESU reduces summer base flows, which limits the establishment of several essential features such as water quality and water quantity. Although watershed restoration activities have improved freshwater critical habitat conditions in isolated areas, reduced habitat complexity, poor water quality, and reduced habitat availability as a result of continuing and historical land management practices continue to persist in many locations.

## 4.3 Klamath and Trinity Rivers Chinook Salmon

Effects from the proposed action will not be further considered in this Opinion for the Shasta River Chinook salmon population of the Klamath and Trinity Rivers Chinook salmon ESU. FGS' operations likely have little impact on this population of Chinook in this watershed. Individuals of the Shasta River Chinook population migrate through the mainstem Klamath River corridor downstream of FGS lands for approximately 20 miles, but exposure to stressors caused by implementation of the HCP are likely to be insignificant to individuals (e.g. exposure to a sediment plume for a short duration). Therefore, we have determined that the Shasta River population of Chinook salmon will not be adversely affected by the proposed action.

### 4.3.1 General Life History

The coastal drainages south of Cape Blanco, Oregon are dominated by the Rogue, Klamath, and Eel Rivers. The Chetco, Smith, Mad, Mattole, and Russian Rivers and Redwood Creek are smaller systems that contain sizable populations of fall-run Chinook salmon (Campbell and Moyle 1990, ODFW 1995). Presently, spring-runs are found in the Rogue, Klamath, and Trinity Rivers; additionally, a vestigial spring-run still exists in the Smith River (Campbell and Moyle 1990, USFS 1995). Historically, fall-run Chinook salmon were predominant in most coastal river systems south to the Ventura River; however, their current distribution in coastal rivers only extends to the Russian River (Healey 1991) located in Mendocino County. There have also been spawning fall-run Chinook salmon reported in small rivers draining into San Francisco Bay (Nielsen et al. 1994).

Of the Pacific salmon, Chinook salmon exhibit arguably the most diverse and complex life history strategies. Healey (1986) described 16 age categories for Chinook salmon, 7 total ages with 3 possible freshwater ages. Two generalized freshwater life-history types were described by Healey (1991): "Stream-type" Chinook salmon reside in freshwater for a year or more following emergence, whereas "ocean-type" Chinook salmon, the most common, migrate to the ocean within their first year.

Typically, Chinook salmon mature between 2 and 6 years of age (Myers et al. 1998). Freshwater entry and spawning timing are generally thought to be related to local water temperature and flow regimes (Miller and Brannon 1982). Runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and actual time of spawning (Myers et al. 1998).

Run timing for spring-run Chinook salmon typically begins in March and continues through July, with peak migration occurring in May and June. Spawning begins in late August and can continue through October, with a peak in September. Historically, spring-run spawning areas were located in the river headwaters (generally above 400 m). Run timing for fall-run Chinook salmon varies depending on the size of the river. Adult Rogue, Upper Klamath, and Eel River fall-run Chinook salmon return to freshwater in August and September and spawn in late October and early November (Stone 1897, Snyder 1931, Nicholas and Hankin 1988, Barnhart 1995). In other coastal rivers and the lower reaches of the Klamath River, fall-run freshwater entry begins later in October, with peak spawning in late November and December - often extending into January (Leidy and Leidy 1984, Nicholas and Hankin 1988, Barnhart 1995).

When they enter freshwater, spring-run Chinook salmon are immature and they must stage for several months before spawning. Their gonads mature during their summer holding period in freshwater. Over-summering adults require cold-water refuges such as deep pools to conserve energy for gamete production, redd construction, spawning, and redd guarding. The upper temperature range for adults holding while eggs are maturing is 15°C (Hinze 1959). The upper preferred water temperature for spawning adult Chinook salmon is 14°C (Bjorn and Reiser 1991). Unusual stream temperatures during spawning migration and adult holding periods can alter or delay migration timing, accelerate or retard mutations, and increase fish susceptibility to diseases. Sustained water temperatures above 27°C are lethal to adults (Cramer and Hammack 1952, Flosi et al. 1998).

Spring-run Chinook salmon eggs generally incubate between October to January, and fall-run Chinook salmon eggs incubate between October and December (Bell 1991). Length of time required for eggs to develop and hatch is dependent on water temperature and is quite variable, typically ranging from 3-5 months. The optimum temperature range for Chinook salmon egg incubation is 7°C to 12°C (Rich 1997). Incubating eggs show reduced egg viability and increased mortality at temperatures greater than 14°C and show 100 percent mortality for temperatures greater than 17°C (Neilson and Banford 1983). Neilson and Banford (1983) and Beacham and Murray (1990) found that developing Chinook salmon embryos exposed to water temperatures of 2°C or less before the eyed stage experienced 100 percent mortality (Flosi et al. 1998). Emergence of spring- and fall-run Chinook salmon fry begins in December and continues into mid-April (Leidy and Leidy 1984, Bell 1991). In addition to temperature, embryo survival rates decrease when fine sediment less than 6.35 mm exceeds 20 percent of the spawning substrate (Bjornn and Reiser 1991).

Chinook salmon populations south of Cape Blanco all exhibit an ocean-type life history. The majority of fish emigrate to the ocean as subyearlings, although yearling smolts can constitute up to approximately one-fifth of outmigrants from the Klamath River Basin, and to a lesser proportion in the Rogue River Basin; however, the proportion of fish which smolt as subyearling versus yearling varies from year to year (Snyder 1931, Schluchter and Lichatowich 1977, Nicholas and Hankin 1988, Barnhart 1995). This fluctuation in age at smoltification is more characteristic of an ocean-type life history. Furthermore, the low flows, high temperatures, and barrier bars that develop in smaller coastal rivers during the summer months would favor an ocean-type (subyearling smolt) life history (Kostow 1995).

Post-emergent fry seek out shallow, near shore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. Fry use woody debris, interstitial spaces in cobble substrates, and undercut banks as cover (Everest and Chapman 1972). As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure. The optimum temperature range for rearing Chinook salmon fry is 10°C to 13°C (Seymour 1956, Rich 1997) and for fingerlings is 13°C to 16°C (Rich 1997).

Ocean-type juveniles enter saltwater during one of three distinct phases. Early migrants enter the ocean soon after yolk reabsorption at 30-45 mm in length (Lister et al. 1971 *op. cit.* Myers et al. 1998; Healey 1991). In most river systems, however, fry emigrate fresh water at 50-150 days post-hatching, and fingerling migrants, which represent the majority of ocean-type emigrants, migrate in the late summer or autumn of their first year. Stream-type Chinook salmon migrate during their second or, more rarely, their third spring. Under natural conditions stream-type Chinook salmon appear to be unable to smolt as subyearlings.

The diet of out-migrating ocean-type Chinook salmon varies geographically and seasonally, and feeding appears to be opportunistic (Healey 1991). Aquatic insect larvae and adults, *Daphnia*, amphipods (*Eogammarus* and *Corophium spp*.), and *Neomysis* have been identified as important food items (Kjelson et al. 1982 *op. cit.* Myers et al. 1998, Healey 1991). The optimal thermal range for Chinook salmon during smoltification and seaward migration is 10°C to 13°C (Rich 1997).

Chinook salmon spend between 1 and 4 years in the ocean before returning to their natal streams to spawn (Myers et al. 1998). Fisher (1994) reported that 87 percent of returning spring-run adults are 3 years old based on observations of adult Chinook salmon trapped and examined at Red Bluff Diversion Dam on the Sacramento River between 1985 and 1991.

### 4.3.2 Range-Wide Upper Klamath and Trinity River ESU Status and Trends

Available historical published abundance information is summarized in Myers et al. (1998). The following are excerpts from this document:

> "Peak run-size in this ESU was estimated to be about 130,000 Chinook salmon in 1912 (from peak cannery pack of 18,000 cases). CALFIREG (1965) estimated spawning escapement of Chinook salmon within the range of this ESU to be about 168,000 adults, split about evenly between the Klamath (88,000) and Trinity (80,000) Rivers.
>
> The 5-year (1992-96) geometric mean of recent spawning escapements to natural spawning areas was about 48,000 fish. Fish returning to the two hatcheries in the basin accounted for 38 percent of the total (natural + hatchery) spawning escapement. Trends in escapement are relatively stable. The long-term trend statistics mask the fact that minimal abundances were observed in all areas in 1989-91, and populations have increased sharply since then.
>
> Previous assessments of stocks within this ESU have identified several stocks as being at risk or of concern. Nehlsen et al. (1991) identified seven stocks as extinct, two stocks (Klamath River spring-run Chinook salmon and Shasta River fall-run Chinook salmon) as at high extinction risk, and Scott River fall-run Chinook salmon as of special concern. Due to lack of information on Chinook salmon stocks that are presumed to be extinct, the relationship of these stocks to existing ESUs is uncertain. They are listed here based on geography and to give a complete presentation of the stocks identified by Nehlsen et al. (1991). Higgins et al. (1992) provided a more detailed analysis of some of the stocks identified by Nehlsen et al. (1991), classifying three Chinook salmon stocks as at risk or of concern. Of the three stocks Higgins et al. (1992) listed as at high risk of extinction, two matched with the Nehlsen et al. (1991) findings (Klamath River spring run and Shasta River fall run), while one stock was added to the list (South Fork Trinity River spring run). Additionally, three Chinook salmon stocks were identified as of special concern. Of these, Higgins et al. (1992) classified one (Scott River fall run) in agreement with that of Nehlsen et al. (1991), while two others (Trinity River spring run and South Fork Trinity River fall run) were additions to the earlier list."

The large disparity in the status of spring- and fall-run populations within the ESU makes risk evaluation difficult. In 1998 NMFS concluded that, because of the relative health of the fall-run populations, Chinook salmon in this ESU are not at significant risk of extinction, nor are they likely to become endangered in the foreseeable future and, therefore, listing was not warranted (63 FR 11482). In early 2011, NMFS received a petition from the Center for Biological Diversity (CBD), Oregon Wild, Environmental Protection Information Center (EPIC) and The Larch Company formally requesting NMFS list Chinook salmon in the Upper Klamath Basin as a threatened or endangered species under the Endangered Species Act, 16 U.S.C. §§ 1531-1544, under one of the following three alternatives: 1) list spring run Chinook salmon as their own

ESU; 2) list spring run Chinook salmon as a distinct population segment; or 3) list the currently recognized ESU containing both spring and fall run Chinook, based primarily on the severe loss of the spring run from the basin. NMFS determined that the petition presented substantial new scientific information indicating that the petitioned actions may be warranted. Upon fully considering the best available scientific and commercial information on the Upper Klamath and Trinity River ESU, NMFS concluded on April 2, 2012 that the petitioned action is not warranted. In reaching this finding, we concluded that spring-run and fall-run Chinook salmon in the Upper Klamath- Trinity River Basin constitute a single ESU and is not in danger of extinction (63 FR 19597) .

### 4.3.3 Current Viability of the Klamath and Trinity Rivers Chinook ESU

As NMFS has determined that the Klamath and Trinity Rivers ESU are not likely to become endangered in the foreseeable future and have not listed the ESU, a viability analysis has not been conducted as has been done for the SONCC coho ESU. However, the following information is available on some of the key components of viability parameters:

*Population Size*

Figure 7 and Table 9 give the historical in-river estimated run sizes of Klamath River Chinook. The Shasta River has been the most historically important Chinook salmon spawning stream in the upper Klamath River, supporting an estimated spawning escapement of 30,700 adults as recently as 1964, and 63,700 in 1935 (PFMC 2008). The estimated escapement in 2008 to the Shasta River was only 2,741 adults, while escapement to the Salmon and Scott Rivers was 1,749 and 3,445 adults, respectively (PFMC 2008). Over the last 11 years the peak estimated in-river run of Klamath River fall Chinook was in 2000 at 218,077 adults (PFMC 2008). In 2009 and 2010, the Klamath River total Chinook runs were estimated at 100,600 and 91,000 adults respectively (PFMC 2011b) indicating a relatively strong return, but still significantly lower than the peak return experienced in 2000.

*Productivity*

With the building of the Iron Gate Dam in the 1960s and the dam at Lake Lewiston on the Trinity River, hatcheries were required as mitigation for dam construction and the subsequent blockage to upstream spawning grounds. Since this time period, the upper Klamath River has received about 7.3 million hatchery produced fall-run Chinook salmon juveniles per year; almost all have been Klamath River stock, and approximately 2.6 million fall-run Chinook salmon and 1.5 million spring-run Chinook salmon have been released in the Trinity River each year, all of which have been of Trinity or Klamath River origin (Myers et al. 1998).

Because of the contributions of hatchery fish as well as natural variation in natural spawners due to factors such as strong brood years, ocean and annual in-river conditions, productivity is known to fluctuate significantly from year to year as demonstrated in Table 8 derived from PFMC (2008). Figure 7 depicts the total in-river runs size estimates for Chinook adults since 1996 in the entire Klamath Basin in comparison to the estimated Klamath River (minus Trinity River adults) adult hatchery and natural production estimates. Based upon available data on run size estimates and individual population estimates for both fall and spring runs, it appears that there has been little change in the abundance levels, trends in abundance, or population growth rates since Myers et al. (1998). However, recent abundance levels of some populations of spring run Chinook are low compared to historical abundance estimates. For example, recent spawner abundance levels of two of the three spring-run population components (Salmon River and South Fork Trinity River) are below 1,000 fish (PFMC 2011a, CDFG 2011a, CDFG 2011b. Since 2002, springtime Pacific Ocean sea surface temperatures have been above or near normal range in seven of the last nine years (NOAA 2010) perhaps offering one explanation that poor ocean conditions in spring months as Chinook smolts are entering the ocean phase of their life-cycle have led to reduced smolt-to-adult survival rates, thus leading to a declining trend in returning adults to the Klamath system. In the recent past, NMFS has been concerned with recent low in-river returns of Chinook salmon in this ESU, but do not believe that productivity is affecting the viability of the ESU.

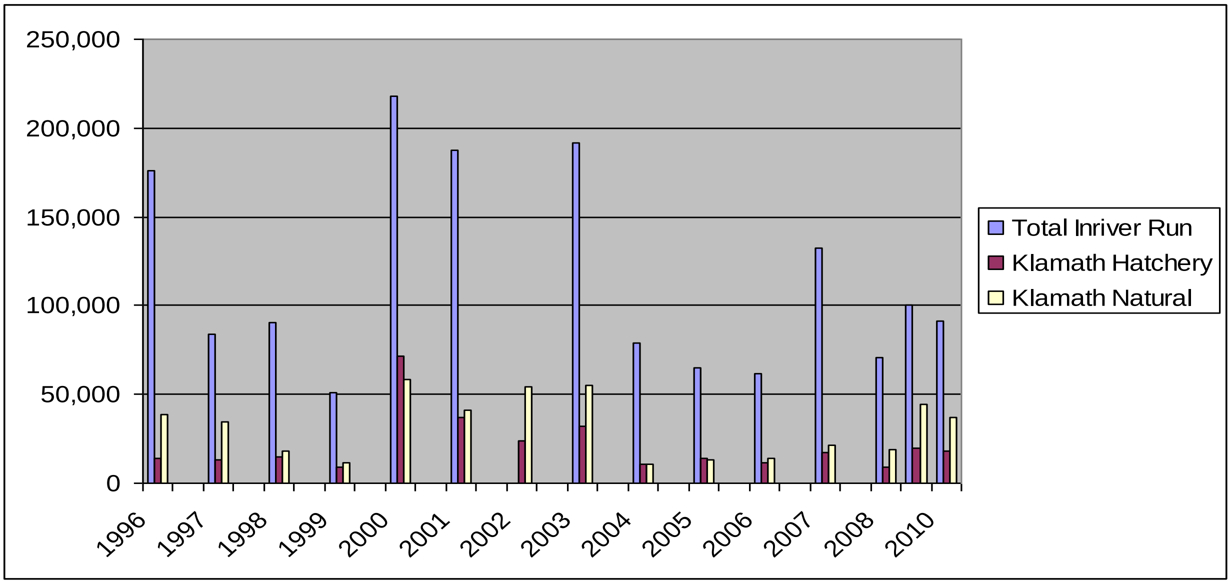


**Figure 7. Total Klamath Basin In-river adult run size estimates in relation to estimated hatchery and natural adult spawner estimates (Figure derived from PFMC 2011a data).**

**Table 8. Summary of Klamath River Fall Chinook salmon estimates (adults & jacks; derived from PFMC 2011a).**

| Year or Average | Category | Total Inriver Run | Inriver Harvest Indian | Sport | Total | Nonlanded Fishery Mortality | Spawning Escapement Klamath River Hatchery | Natural | Total | Trinity River Hatchery | Natural | Total | Total Hatchery | Natural | Tot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1978-1980 | Adults | 63,306 | 14,621 | 2,777 | 17,398 | 1,329 | 3,886 | 21,277 | 25,163 | 3,823 | 15,593 | 19,416 | 7,709 | 36,871 | 44, |
| | Jacks | 23,731 | 1,379 | 3,385 | 4,764 | 189 | 544 | 8,224 | 8,768 | 1,515 | 8,495 | 10,010 | 2,059 | 16,719 | 18, |
| 1981-1985 | Adults | 63,230 | 17,128 | 5,096 | 22,224 | 1,593 | 8,812 | 16,313 | 25,125 | 2,934 | 11,354 | 14,288 | 11,746 | 27,667 | 39, |
| | Jacks | 29,811 | 1,287 | 6,447 | 7,734 | 243 | 1,162 | 6,227 | 7,389 | 4,888 | 9,556 | 14,444 | 6,050 | 15,783 | 21, |
| 1986-1990 | Adults | 151,203 | 36,669 | 15,145 | 51,814 | 3,498 | 13,194 | 21,543 | 34,737 | 11,912 | 49,242 | 61,154 | 25,106 | 70,785 | 95, |
| | Jacks | 20,227 | 446 | 4,924 | 5,370 | 139 | 1,009 | 3,460 | 4,469 | 2,285 | 7,964 | 10,248 | 3,294 | 11,423 | 14, |
| 1991-1995 | Adults | 80,666 | 10,574 | 3,094 | 13,668 | 983 | 12,980 | 26,594 | 39,574 | 5,104 | 21,339 | 26,442 | 18,084 | 47,932 | 66, |
| | Jacks | 12,038 | 291 | 2,741 | 3,032 | 81 | 1,140 | 3,216 | 4,356 | 1,134 | 3,435 | 4,569 | 2,274 | 6,651 | 8,9 |
| 1996 | Adults | 175,773 | 56,476 | 12,766 | 69,242 | 5,172 | 13,622 | 38,680 | 52,302 | 6,411 | 42,646 | 49,057 | 20,033 | 81,326 | 101 |
| | Jacks | 9,532 | 190 | 2,312 | 2,502 | 64 | 543 | 1,696 | 2,239 | 249 | 4,478 | 4,727 | 792 | 6,174 | 6,9 |
| 1997 | Adults | 83,736 | 12,087 | 5,676 | 17,763 | 1,167 | 13,275 | 34,637 | 47,912 | 5,387 | 11,507 | 16,894 | 18,662 | 46,144 | 64, |
| | Jacks | 7,993 | 35 | 2,409 | 2,444 | 52 | 452 | 1,380 | 1,832 | 820 | 2,845 | 3,665 | 1,272 | 4,225 | 5,4 |
| 1998 | Adults | 90,647 | 10,187 | 7,710 | 17,897 | 1,043 | 14,923 | 18,028 | 32,951 | 14,296 | 24,460 | 38,756 | 29,219 | 42,488 | 71, |
| | Jacks | 4,639 | 53 | 1,108 | 1,161 | 28 | 403 | 881 | 1,284 | 192 | 1,974 | 2,166 | 595 | 2,855 | 3,4 |
| 1999 | Adults | 51,048 | 14,660 | 2,282 | 16,942 | 1,322 | 9,290 | 11,660 | 20,950 | 5,037 | 6,797 | 11,834 | 14,327 | 18,457 | 32, |
| | Jacks | 19,248 | 271 | 1,616 | 1,887 | 57 | 4,830 | 6,293 | 11,123 | 2,027 | 4,154 | 6,181 | 6,857 | 10,447 | 17, |
| 2000 | Adults | 218,077 | 29,415 | 5,650 | 35,065 | 2,673 | 71,635 | 58,388 | 130,023 | 25,976 | 24,340 | 50,316 | 97,611 | 82,728 | 180 |
| | Jacks | 10,246 | 303 | 1,582 | 1,885 | 58 | 839 | 2,891 | 3,730 | 1,070 | 3,503 | 4,573 | 1,909 | 6,394 | 8,3 |
| 2001 | Adults | 187,333 | 38,645 | 12,134 | 50,779 | 3,608 | 37,204 | 40,944 | 78,148 | 17,908 | 36,890 | 54,798 | 55,112 | 77,834 | 132 |
| | Jacks | 11,343 | 399 | 1,500 | 1,899 | 66 | 1,364 | 6,378 | 7,742 | 267 | 1,369 | 1,636 | 1,631 | 7,747 | 9,3 |
| 2002 | Adults | 160,788 a/ | 24,574 | 10,495 | 35,069 | 2,351 | 23,667 | 54,225 | 77,892 | 3,516 | 11,410 | 14,926 | 27,183 | 65,635 | 92, |
| | Jacks | 9,226 | 126 | 870 | 996 | 29 | 1,294 | 1,529 | 2,823 | 1,037 | 2,338 | 3,375 | 2,331 | 3,867 | 6,1 |
| 2003 | Adults | 191,949 | 30,034 | 9,680 | 39,714 | 2,810 | 31,970 | 55,423 | 87,393 | 29,812 | 32,219 | 62,031 | 61,782 | 87,642 | 149 |
| | Jacks | 3,845 | 44 | 814 | 858 | 21 | 290 | 848 | 1,138 | 574 | 1,254 | 1,828 | 864 | 2,102 | 2,9 |
| 2004 | Adults | 78,943 | 25,803 | 4,003 | 29,806 | 2,325 | 10,582 | 10,711 | 21,293 | 12,399 | 13,120 | 25,519 | 22,982 | 23,831 | 46, |
| | Jacks | 9,646 | 168 | 2,741 | 2,909 | 71 | 937 | 846 | 1,783 | 1,044 | 3,839 | 4,883 | 1,980 | 4,685 | 6,6 |
| 2005 | Adults | 65,227 | 8,016 | 1,985 | 10,001 | 738 | 13,955 | 13,554 | 27,509 | 13,744 | 13,235 | 26,979 | 27,699 | 26,789 | 54, |
| | Jacks | 2,296 | 70 | 1,030 | 1,100 | 27 | 42 | 398 | 440 | 59 | 670 | 729 | 101 | 1,068 | 1,1 |
| 2006 | Adults | 61,374 | 10,283 | 62 | 10,345 | 1,344 | 11,604 | 14,264 | 25,868 | 7,918 | 15,899 | 23,817 | 19,522 | 30,163 | 49, |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jacks | 26,935 | 415 | 5,527 | 5,942 | 149 | 2,386 | 6,516 | 8,902 | 4,076 | 7,866 | 11,942 | 6,462 | 14,382 | 20, |
| 2007 | Adults | 132,131 | 27,573 | 6,312 | 33,885 | 2,526 | 16,969 | 21,292 | 38,261 | 18,081 | 39,378 | 57,459 | 35,050 | 60,670 | 95, |
| | Jacks | 1,684 | 21 | 369 | 390 | 10 | 180 | 232 | 412 | 33 | 839 | 872 | 213 | 1,071 | 1,2 |
| 2008b/ | Adults | 70,572 | 22,259 | 1,863 | 24,122 | 1,973 | 9,101 | 19,020 | 28,121 | 4,451 | 11,905 | 16,356 | 13,552 | 30,925 | 44, |
| | Jacks | 25,338 | 641 | 4,253 | 4,894 | 143 | 2,130 | 9,425 | 11,555 | 800 | 7,946 | 8,746 | 2,930 | 17,371 | 20, |
| GOAL | Adults | | | | | | | | | | | | | ≥35,000c/ | |

a/ Total inriver run includes an estimated 30,550 fish that died prior to spawning in September 2002.
b/ Preliminary.
c/ In 2008, fisheries were managed for a natural area spawning escapement of 40,700 adults.

*Spatial Structure*

There are four main tributaries in the ESU that support the majority of the natural and hatchery reared adult population. Heading from west to east they are: Trinity River, Salmon River, Scott River, and the Shasta River. There are smaller tributaries throughout the basin which support small runs of Chinook, such as Beaver Creek in the Middle Klamath.

Myers et al. (1998) reported that habitat loss and/or degradation is commonplace throughout the range of the ESU. Dam construction has blocked hundreds of miles of spawning habitat in the Upper Klamath and Trinity River Basins. Other blockages throughout the range of the ESU occur from agricultural diversions and water extraction. Water diversions and extractions in the Scott and Shasta River basins often lead to low-flow conditions which results in blockage of upstream habitat when the fall run occurs. Fifty percent of the spawning habitat in the Trinity River Basin was lost following the construction of Lewiston Dam at RKm 249 (Moffett and Smith 1950). In summary, although significant events have occurred in the ESU range that have substantially reduced the spatial structure of Klamath and Trinity Chinook salmon populations, such as dam installations, the remaining habitat accessible to Chinook salmon does not appear restricted to such an extent that it is affecting the viability of this species.

*Diversity*

Spring-run Chinook salmon were once the dominant run type in the Klamath-Trinity River Basin and are believed to have encompassed most of adults in the ESU before dam construction and corresponding hatchery production began to occur. The estimates of spring-run adults now averages in the 100's since the 1980's (Anderson 2003). Most spring-run spawning and rearing habitat was blocked by the construction of dams in the late 1800s and early 1900s in the Klamath River Basin, and in the 1960s in the Trinity River Basin (Myers et al. 1998). It is believed at least seven (7) spring-run populations that once existed in the basin are now considered extinct (Myers et al. 1998).

Hatchery production in the ESU basin has been and continues to be substantial, with considerable potential for interbreeding between natural and hatchery produced adults. The degree to which interbreeding continues to occur is relatively unknown, but nonetheless, is a concern for retaining genetic diversity amongst the remaining natural population of the ESU (Myers et al. 1998).

Although there is concern regarding the depressed status of the spring-run phenotype in the ESU, at this time NMFS does not believe a loss of genetic diversity has occurred to such an extent that two separate ESU's (spring-run and fall run) are warranted for classification. There is concern regarding further loss of spring-run sub-populations in the basin, however NMFS does not believe the loss of spring-run phenotypes impacts the viability of the overall ESU (Myers et al. 1998).

*Viability Summary*

Based on the above descriptions of the population viability parameters, NMFS believes that the Klamath and Trinity Rivers ESU is currently viable and is not at risk of extinction.

## 4.4 Klamath Mountains Province Steelhead

Effects from the proposed action will not be further considered in this Opinion for the Shasta River steelhead population of Klamath Mountains Province steelhead ESU. FGS' operations likely have little impact on this population of steelhead in this watershed. Individuals of the Shasta River steelhead population migrate through the mainstem Klamath River corridor downstream of FGS lands for approximately 20 miles, but exposure to stressors caused by implementation of the HCP are likely to be insignificant to individuals (e.g., exposure to a sediment plume for a short duration). Therefore, we have determined that the Shasta River population of Klamath Mountains Province steelhead will not be adversely affected by the proposed action.

### 4.4.1 General Life History

Biologically, steelhead can be divided into two basic run-types, based on the state of sexual maturity at the time of river entry and duration of spawning migration (Burgner et al. 1992 *op. cit.* Busby et al. 1996). The stream-maturing type, or summer steelhead, enters freshwater in a sexually immature condition and requires several months in fresh water to mature and spawn. The ocean-maturing type, or winter steelhead, enters fresh water with well-developed gonads and spawns shortly after river entry (Barnhart 1986). Variations in migration timing exist between populations. Some river basins have both summer and winter steelhead, while others only have one run-type. South of Cape Blanco, Oregon, summer steelhead are known to occur in the Rogue, Smith, Klamath, Trinity, Mad, Mattole, and Eel Rivers, and in Redwood Creek (Busby et al. 1996).

Summer steelhead enter freshwater between May and October in the Pacific Northwest (Busby et al. 1996, Nickelson et al. 1992). They require cool, deep holding pools during summer and fall, prior to spawning (Nickelson et al. 1992). They migrate inland toward spawning areas, overwinter in the larger rivers, resume migration in early spring to natal streams, and then spawn (Meehan and Bjornn 1991, Nickelson et al. 1992) in January and February (Barnhart 1986).

Winter steelhead enter freshwater between November and April in the Pacific Northwest (Busby et al. 1996, Nickelson et al. 1992), migrate to spawning areas, and then spawn, generally in April and May (Barnhart 1986). Some adults, however, do not enter some coastal streams until spring, just before spawning (Meehan and Bjornn 1991).

There is a high degree of overlap in spawn timing between populations regardless of run-type (Busby et al. 1996). Difficult field conditions at that time of year and the remoteness of spawning grounds contribute to the relative lack of specific information on steelhead spawning. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby et al. 1996). However, steelhead rarely spawn more than twice before dying; most that do so are females (Nickelson et al. 1992). Iteroparity is more common among southern steelhead populations than northern populations (Busby et al. 1996).

Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity. Intermittent streams may be used for spawning (Barnhart 1986, Everest 1973). Steelhead enter streams and arrive at spawning grounds weeks or even months before they spawn and are vulnerable to disturbance and predation. Cover, in the form of overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water, turbulence, and turbidity (Giger 1973 *op. cit.* Bjornn and Reiser 1991) are required to reduce disturbance and predation of spawning steelhead. It appears that summer steelhead occur where habitat is not fully utilized by winter steelhead; summer steelhead usually spawn further upstream than winter steelhead (Withler 1966 *op. cit.* Busby et al. 1996, Behnke 1992).

Steelhead require a minimum depth of 0.18 m and a maximum velocity of 2.44 m/s for active upstream migration (Smith 1973). Spawning and initial rearing of juvenile steelhead generally take place in small, moderate-gradient (generally 3-5 percent) tributary streams (Nickelson et al. 1992). A minimum depth of 0.18 m, water velocity of 0.30-0.91 m/s (Smith 1973, Thompson 1972), and clean substrate 0.6-10.2 cm (Hunter 1973 *op. cit.* Bjornn and Reiser 1991, Nickelson et al. 1992) are required for spawning. Spence et al. (1996) stated that mortality of coho salmon and steelhead occurs when fine sediment (<0.85mm) exceeds 13 percent of the substrate composition.

Steelhead spawn in 3.9-9.4°C water (Bell 1991). Depending on water temperature, steelhead eggs may incubate for 1.5 to 4 months before hatching, generally between February and June (Bell 1991). Bjornn and Reiser (1991) noted that steelhead eggs incubate about 85 days at 4°C and 26 days at 12°C to reach 50 percent hatch. Nickelson et al. (1992) stated that eggs hatch in 35-50 days, depending upon water temperature.

Following yolk sac absorption, alevins emerge from the gravel and begin actively feeding. After emerging from the gravel, fry usually inhabit shallow water along banks of perennial streams. Young fry occupy stream margins (Nickelson et al. 1992) while maturing fry establish and defend territories.

Summer rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small wood. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson et al. 1992).

Juvenile steelhead migrate little during their first summer and occupy a range of habitats featuring moderate to high water velocity and variable depths (Bisson et al. 1988). Rearing juveniles prefer water temperatures ranging from 12-15°C (Reeves et al. 1987). Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects (Chapman and Bjornn 1969), and older juveniles sometimes prey on emerging fry. Steelhead hold territories close to the substratum where flows are lower and sometimes counter to the main stream; from these, they can make forays up into surface currents to take drifting food (Kalleberg 1958). Juveniles rear in freshwater from 1 to 4 years (usually 2 years in the California populations), then smolt and migrate to the ocean in March and April (Barnhart 1986). Winter steelhead juveniles generally smolt after 2 years in freshwater (Busby et al. 1996). Steelhead smolts are usually 15-20 cm total length and migrate to the ocean in the spring (Meehan and Bjornn 1991). Juvenile steelhead tend to migrate directly offshore during their first summer from whatever point they enter the ocean rather than migrating along the coastal belt as salmon do. During the fall and winter, juveniles move southward and eastward (Hartt and Dell 1986 *op. cit.* Nickelson et al. 1992).

Steelhead typically reside in marine waters for 2 or 3 years prior to returning to their natal stream to spawn as 4- or 5-year olds. Populations in Oregon and California have higher frequencies of age-1 ocean steelhead than populations to the north, but age-2 ocean steelhead generally remain dominant (Busby et al. 1996). Age structure appears to be similar to other west coast steelhead, dominated by 4-year-old spawners (Busby et al. 1996). Some steelhead return to fresh water after only 2 to 4 months in the ocean and are termed "half-pounders" (Snyder 1925). Half-pounders generally spend the winter in fresh water and then out migrate again the following spring for several months before returning to fresh water to spawn. Half-pounders occur over a relatively small geographic range in southern Oregon and northern California, and are only reported in the Rogue, Klamath, Mad, and Eel Rivers (Snyder 1925, Barnhart 1986, Kesner and Barnhart 1972, and Everest 1973).

### 4.4.2 Range-wide Klamath Mountains Province Steelhead (ESU) Status and Trends

The KMP steelhead ESU occupies rivers basins from the Elk River in Oregon south to the Klamath and Trinity Rivers in California, inclusive. In the California side of the ESU, primary river systems include the Smith, Klamath, and Trinity River Basins. The final listing determination (*i.e.*, not warranted) for the KMP steelhead ESU was provided on April 4, 2001 (66 FR 17845). An initial status review on KMP steelhead was presented by Busby et al. (1994) and updated in NMFS (2001b). Busby et al. (1994) identified five areas of concern regarding the abundance of steelhead within the ESU:

1. Although historical trends in overall abundance within the ESU are not clearly understood, there has been a substantial replacement of natural fish with hatchery fish.

2. Since about 1970, trends in abundance have been downward in most steelhead populations within the ESU, and a number of populations are considered by various agencies and groups to be at moderate to high risk of extinction.

3. Declines in summer steelhead populations are of particular concern.

4. Most populations of steelhead within the area experience a substantial infusion of hatchery fish that spawn in the wild each year. After accounting for the contribution of these hatchery fish, we are unable to identify any steelhead populations that are naturally self-sustaining.

5. Total abundance of adult steelhead remains fairly large (above 10,000 individuals) in several river basins within the region, but several basins have runs below 1,000 adults per year.

As part of a status review update (NMFS 2001b), these concerns were revisited with more recent data. These data suggested that:

1. The proportion of naturally spawning hatchery fish, at least in Oregon, is much lower than indicated by data available for the initial steelhead status review (Busby et al. 1994). This information increased confidence that naturally

sustaining populations are more widely distributed throughout this ESU than previously thought.

2. New information provided information that abundance of natural fish in this ESU is probably at least 50,000 adults and may exceed 100,000.

3. Trends in abundance were mixed across the ESU following steep declines up to the 1980s.

These findings, coupled with NMFS' conclusion that existing conservation efforts are collectively benefiting steelhead in this ESU, formed the basis for the decision that the KMP steelhead ESU does not warrant listing under the ESA (66 FR 17845; April 4, 2001).

### 4.4.3 Current Viability of the Klamath Mountains Province Steelhead ESU

*Viability of the ESU*

As NMFS has determined that the Klamath Mountains Province steelhead ESU are not likely to become endangered in the foreseeable future and have not listed the ESU, a viability analysis has not been conducted as has been done for the SONCC coho ESU. However, the following information is available on some of the key components of viability parameters:

*Population Size*

The most recent status review conducted for the ESU (NMFS 2001b) found that the Oregon winter-run steelhead populations in this ESU appeared relatively stable or may be on an increasing trend. For example, Applegate River natural spawners increased from 906 to 1,325 spawners from 1993-1997. Upper Rogue River spawners remained relatively constant during the same time period at 6,838 to 6,789. Oregon conducted an extrapolation of data based on total miles of steelhead habitat and calculating juvenile to adult survival rates, and derived annual estimates in the range 69,000 to 83,000 adults in the Oregon-KMP populations (NMFS 2001b).

In a recent ODFW (Suring and Lewis 2008) report on surveys of redds in the Oregon portion of the ESU it was estimated that 13,903 wild produced redds existed in the Rogue River basin below Gold Ray Dam. This redd estimate was similar to other years. Surveyors also determined that the density of redds in the South Coast Management Area (Oregon) was higher than in the Rogue Management Area, at 21 redds/mile compared to 13 redds/mile, although this stratum had a higher proportion of hatchery steelhead distributed across the monitoring area. In the Rogue MA only the Applegate population was determined to have a significant level of hatchery produced spawners in the system, but overall hatchery influence in the Rogue MA was thought to be small (Suring and Lewis 2008).

Data for the Klamath River population is not as robust as the Oregon survey program; however, the fall-run steelhead population appears to have shown an upward trend since the late 1990's. Koch (2001) reported that catch records for natural fall and winter-run steelhead on the Klamath and Trinity Rivers appear to be increasing. In the Trinity River, counts at Willow Creek weir provide an estimate of about 2,000 natural origin fall-run spawners per year (NMFS 2001b).

Although data sets on population run sizes are limited, California biologists, using professional judgment and an assumption that largely unsampled winter-run populations are the most abundant, estimated natural escapement in the California part of this ESU to be approximately 30,000–50,000 adults per year. Combining California estimates with that of Oregon, NMFS suggested a total abundance of naturally spawning steelhead in the ESU to lie between 100,000–130,000 adults (NMFS 2001b).

Both Oregon and California data report a declining trend for summer-run steelhead in the ESU; however, there are three run types included in the ESU, so increases in the number of fall/winter run mask the declining trend in the summer-run phenotype. NMFS does not believe population size risks the viability of this ESU.

*Productivity*
The KMP ESU is affected by hatchery contributions both in Oregon and California. In Oregon, hatcheries occur within the Rogue River basin at the Cole and Applegate Rivers, and on the Chetco River a hatchery occurs downstream of the North Fork (NMFS 2001b). ODFW (2004) estimated that a minimal number of naturally spawning steelhead within the Oregon-KMP streams were of hatchery origin with the exception of Applegate and Chetco Rivers which are believed to have 25 percent and 50 percent of hatchery origin spawners, respectively.

The Trinity River steelhead population is thought to contain a large percentage of hatchery origin spawners (20-70 percent) (NMFS 2001b). The hatchery program on the Trinity propagates mostly fall-run fish, which suggests that adults found outside of the run-type are likely of natural origin. To the contrary, it is believed the return of hatchery origin adults in the Klamath River has been so poor, that most adults in the basin are likely to be of natural origin (Koch 2001). In the Smith River, hatchery origin adults may be as high as 27-37 percent of returning adults (NMFS 2001b). In conclusion, the abundance of hatchery origin natural spawners is thought to be limited, but potentially significant in the Applegate, Trinity, Smith and Chetco Rivers; however, the degree of hatchery influences is not believed to risk the viability of this ESU.

*Diversity*
Of primary concern for KMP steelhead is the declining trend range-wide in the summer-run phenotype. There is little empirical evidence of the historical distribution or overall abundance of summer steelhead. However, it is believed that summer steelhead occurred mostly in the upper parts of the major river basins. Due to the construction of dams in these major rivers, considerable summer steelhead habitat may have been lost (NMFS 2001b).

Although hatchery influences are also a concern for the fall/winter runs in major river basins, at a range-wide scale, it is not believed that loss of diversity for these phenotypes risk the viability of this ESU.

*Spatial Structure*
The NMFS BRT (2001b) concluded that juvenile abundance data suggested that KMP steelhead were well distributed throughout the Oregon part of the ESU, even though declining distribution of summer steelhead was a concern as habitat was lost throughout the ESU due to dam construction and other impassible barriers.

Although the BRT is concerned with the spatial distribution of the summer-run phenotype, fall/winter-run phenotypes appear to be fairly broadly distributed throughout the ESU. In summary, limited spatial distribution does not appear to risk the viability of the ESU.

*Viability Summary*

Based on the above descriptions of the population viability parameters, NMFS believes that the KMP steelhead ESU is currently viable and is not at risk of extinction.

## 4.5 Status of Klamath and Trinity Rivers Chinook salmon and KMP Steelhead Critical Habitat

Because neither species warrants listing under the ESA, there is no designated critical habitat for Klamath and Trinity Rivers Chinook salmon or KMP steelhead. Therefore, no critical habitat analysis is included in this Opinion for these species. Should these species become listed and have critical habitat designated during the permit term, this Opinion may be amended to include new critical habitat designation(s).

## 4.6 Factors Responsible for the Current Status of SONCC coho, Klamath and Trinity Rivers Chinook, and KMP steelhead

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

### 4.6.1 Water Diversions and Habitat Blockages

Stream-flow diversions are common throughout the species' ranges. Unscreened diversions for agricultural, domestic and industrial uses are a significant factor for salmonid declines in many basins. Reductions in flows during summer can strand fish, trigger pre-mature emigration to other areas and increase competitive pressures as available habitat shrinks. Reduced stream-flows due to diversions reduce the amount of habitat available to salmonids and can degrade water quality, such as causing water temperatures to elevate more easily. Reductions in water quantity can also reduce a system's carrying capacity limiting population growth in the affected reaches. Surface waters may warm if they are diverted to areas without sufficient riparian cover. Water not used in the diversion and use process may return to the original system with elevated temperatures. These warm return flows may cause fish in the receiving area to seek reaches with cooler water, thus increasing competitive pressures in other areas. Changes in the stream flow regime can also influence disease proliferation and this is discussed further in a later section.

The Klamath River watershed is listed by the California State Water Resources Control Board as impaired for temperature, nutrients, and dissolved oxygen. The Scott River watershed is listed as impaired for sediment and temperature.

The maximum floating weekly average temperature (MWAT) is often used in regional studies as an index for assessing temperature-driven stress to salmonids (NCRWQCB 2005, Lewis et al. 2000). Use of both MWAT and maximum weekly maximum temperature (MWMT) have been recommended for assessing the suitability of stream temperatures for juvenile coho salmon during late summer (Sullivan et al. 2000). MWAT is the mathematical mean of multiple, equally spaced daily temperatures over a 7-day consecutive period. MWMT is the mathematical mean of multiple, daily maximum temperatures over a 7-day consecutive period. Work by Welsh et al. (2001) and Hines and Ambrose (1998) in coastal northwestern California found that coho salmon juveniles were absent in streams where the MWAT exceeded 16.8 °C. When temperatures are warmer than suitable for SONCC coho salmon, disease resistance decreases, and may result in fish mortality (USFWS 2003). Water temperatures in the mainstem Klamath and Scott Rivers are typically lethal for SONCC coho salmon from late June until September, with average seven-day maximum temperatures commonly exceeding 24°C, and sometimes approaching 27 °C . Thermal refugia associated with tributary mouths and seeps provide important summer holding and rearing sites for SONCC coho salmon when mainstem river temperatures become lethal to fish.

Several dams on the Rogue River in Oregon were built over the last century, but in recent years several have been removed or are in the process of being removed. The percentage of habitat loss for steelhead is presumably greatest because steelhead were more extensively distributed upstream than Chinook salmon or coho. As a result of migration barriers, salmon, steelhead, and coho populations have largely been confined to lower elevation mainstems that historically were primarily used for migration and rearing. Higher temperatures at these lower elevations during late-summer and fall are also a major stressor to adult and juvenile salmonids. As a result of such loss of quantity, quality, and spatial distribution of spawning and rearing habitats over the past 100 years, population abundances have declined in many streams (Lindley et al. 2009).

### 4.6.2 Timber Harvest

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

Timber harvesting activities can have significant effects on hydrologic processes that determine streamflow. The type and extent of silvicultural methods and road construction alter runoff by accelerating surface flows from hillsides to stream channels (Chamberlin et al. 1991, McIntosh et al. 1994). These accelerated flows can increase peak flows during rainstorms (Ziemer 1998). Examples of how timber harvest may increase peak flow include: 1) removal of vegetation to an extent that evapotranspiration is reduced, which can increase the amount of water that infiltrates the soil and ultimately reaches the stream, 2) soil compaction caused by heavy equipment that decreases infiltration capabilities, resulting in increased surface runoff, 3) forest management activities that substantially disturb the soil, such as yarding, burning, or road and skid trail construction, may alter both surface and subsurface pathways that transport water to streams (Thomas et al. 1993, Murphy 1995, Keppeler and Brown 1998), 4) logging that results in an alteration of the internal soil structure where operations have occurred. As tree roots die, soil "macropores" collapse or are filled in with sediment. These subsurface pathways are important for water transmission. When subsurface flow pathways are destroyed, the flow may be routed to the surface and increase gully erosion and sediment delivery (Keppeler and Brown 1998), and 5) ditches associated with roads collect run-off and intercept subsurface flows and route them to streams more quickly. Such roads can act as first order streams and channel more water directly into larger streams (Wemple 1994). Timber harvest methods that lead to increased peak flows can have direct effects on salmon because the resulting increased stream power can scour stream channels, killing incubating eggs, and displacing juvenile salmon from winter cover (McNeil 1964, Tschaplinski and Hartman 1983).

In the smaller upland watercourses, in-channel wood usually remains in place and acts as check-dams that store sediment eroded from hillsides (Reid 1998). Sediment storage in smaller streams can persist for decades (Nakamura and Swanson 1993). In assessing the characteristics of ephemeral upland watercourses including within the Mad River watershed, Simpson (2002) found that coniferous woody debris was the predominant channel bed grade control. Conifers provide the most functional woody debris, in terms of adding habitat structure and complexity, because they are larger and more resistant to decay. Furthermore, where channels are prone to sediment debris flows, woody debris and adjacent riparian stands can provide roughness that limit the distance debris flows may travel down into channels (Ketcheson and Froehlich 1978, Pacific Watershed Associates (PWA) 1998). Recent studies have indicated that steep, higher order watercourses can contribute LWD to a lower order watercourse through mass-wasting events like debris torrents (May 2002, Montgomery 2003, Reeves 2003, May and Gresswell 2004). This accumulation of LWD at the base of a debris flow can also serve to retain and gradually meter sediment into the Class I watercourse. For example, in Bear Creek, a tributary to the Eel River, PWA (1998) noted that debris flows now travel farther downstream and channel aggradation extends farther downstream because of inadequate large wood from landslide source areas and streamside vegetation. Timber harvest that removes wood located in higher order channels, or removes trees providing bank stability can reduce the amount and size of LWD delivered to fish-bearing streams via landslide events, as well as increase the delivery of sediment to such streams.

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

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

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

#### 4.6.3 Road Construction

Road construction, whether associated with timber harvest or other activities, has caused widespread impacts to salmonids (Furniss et al. 1991). Where roads cross salmonid-bearing streams, improperly placed culverts have blocked access to many stream reaches. For example Appendix D of USDA-FS (2004) lists all known human-made fish passage barriers and potential barriers along with the amount of upstream anadromous fish habitat to which access will be reestablished when barriers are removed. Many of the sites proposed are circular culverts or low flow fords that are barriers or potential barriers to fish passage. Such road crossing barriers typically result from installation of culverts that are undersized and/or placed at the wrong slope (NMFS 2003).

Landsliding and chronic surface erosion from road surfaces are large sources of sediment across the affected species' ranges. Roads also have the potential to increase peak flows and reduce summer base flows with consequent effects on the stability of stream substrates and banks. Roads have led to widespread impacts on salmonids by increasing the sediment loads. The consequent impacts on habitat include reductions in spawning, rearing and holding habitat, and increases in turbidity.

The delivery of sediment to streams can be generally considered as either chronically delivered, or more episodic in nature. Chronic delivery, or surface erosion, occurs through rainsplash and overland flow. Therefore, surface erosion occurs often and is associated with rainfall. More episodic delivery, on the order of every few years, occurs in the form of mass wasting events, or landslides, that deliver large volumes of sediment during large storm events.

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

Construction of road networks can also greatly accelerate erosion rates within a watershed (Haupt 1959, Swanson and Dyrness 1975, Swanston and Swanson 1976, Reid and Dunne 1984, Hagans and Weaver 1987). Once constructed, existing road networks can be a chronic source of sediment to streams (Swanston 1991) and are generally considered the main cause of accelerated surface erosion in forests across the western United States (Harr and Nichols 1993). Processes that can be initiated or affected by roads include landslides, surface erosion, secondary surface erosion (landslide scars exposed to rainsplash), and gullying. Historically, roads and related ditch networks were often connected to streams via surface flow paths, providing a direct conduit for sediment; however, more modern forest practices are engaging in disconnection of these delivery pathways. Where roads and ditches are maintained periodically by blading, the amount of sediment delivered continuously to streams may temporarily increase as bare soil is exposed and ditch roughness features which store and route sediment and also armor the ditch are removed. Hagans and Weaver (1987) found that fluvial hillslope erosion associated with roads in the lower portions of the Redwood Creek watershed produced about as much sediment as landslide erosion between 1954 and 1980.

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

### 4.6.4 Hatcheries

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

Spawning by hatchery salmon is often not controlled (ISAB 2002). Hatchery fish also stray into other rivers and streams, transferring genes from hatchery populations into naturally spawning populations (Pearse 2007). Hatchery programs alter the genetic composition (Reisenbichler and

Rubin 1999, Ford 2002), phenotypic traits (Kostow 2004), and behavior (Berejikian et al. 1996) of reared fish. Genetic mixing between hatchery and naturally produced stocks decreases the genetic and phenotypic diversity of a species by homogenizing once disparate traits of hatchery and natural fish. The result is progeny with lower survival rates (McGinnity et al. 2003, Kostow 2004) and ultimately, a reduction in the fitness of the natural stock (Reisenbichler and McIntyre 1977, Chilcote 2003, Araki et al. 2007) and outbreeding depression (Reisenbichler and Rubin 1999, HSRG 2004).

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

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

### 4.6.5 Predation

Predation is unlikely to play a major role in the decline of salmon populations; however, it may have had substantial impacts at local levels. For example, Higgins et al. (1992) and CDFG (1994) reported that Sacramento River pikeminnow have been found in the Eel River basin and are considered a major threat to native salmonids such as SONCC coho salmon. Furthermore, populations of California sea lions and Pacific harbor seals, known predators of salmonids which occur in most estuaries and rivers where salmonid runs occur on the West Coast, have increased to historical levels because, among other things, killing of these animals has been prohibited by the Marine Mammal Protection Act of 1972. However, salmonids appear to be a minor component of the diet of many marine mammals (Scheffer and Sperry 1931, Jameson and Kenyon 1977, Graybill 1981, Brown and Mate 1983, Roffe and Mate 1984, Hanson 1993). In the original listing of the SONCC coho salmon ESU (May 6, 1997, 62 FR 24588) NMFS indicated that it was unlikely that pinniped predation was a significant factor in the decline of coho salmon on the west coast, although they may be a threat to existing depressed local populations. NMFS determined that although pinniped predation did not cause the decline of salmonid populations, predation may preclude recovery of these populations in localized areas where they co-occur with salmonids, especially where salmonids concentrate or passage may be constricted. NMFS has not identified specific areas where pinniped predation may preclude recovery of coho salmon populations.

Normally, predators play an important role in the ecosystem, culling out weak or unfit individuals. The increased impact of certain predators has been, to a large degree, the result of ecosystem modification. Therefore, it would seem more likely that increased predation is but a symptom of a much larger problem, namely, habitat modification and decreases in water quantity and quality. With the decrease in quality riverine and estuarine habitats, increased predation by freshwater, avian, and marine predators may occur. Without adequate avoidance habitat (e.g., deep pools and estuaries, and undercut banks) and adequate migration and rearing flows, predation may play a role in the reduction of some coho salmon populations (Wright et al. 2007, Goodwin and Cuffe 1993).

### 4.6.6 Disease

Relative to effects of overfishing, habitat degradation, and hatchery practices, it is unlikely that disease plays a major role in the decline of salmon populations. However, disease may substantially impact and limit recovery of local salmon populations. Although naturally occurring, many of the diseases salmon currently face are exacerbated by human-induced environmental factors such as water regulation (damming and diverting) and habitat alteration.

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

Ceratomyxosis, which is caused by *C. shasta*, has recently been identified as one of the most significant diseases for juvenile salmon due to its prevalence and impacts in the Klamath Basin (Nichols et al. 2007). Mortality rates from temporary and longer term exposures at various locations in the Klamath River vary between location, months and years, but are consistently high (10-90 percent) (Bartholomew 2007). Adults in the Klamath basin are also largely impacted by disease, primarily from the common pathogens *Ichthyopthirius multifilis* (Ich) and *Flavobacterium columnare* (columnaris) (CETFKRB NRC 2004). These pathogens were responsible for the 2002 fish kill on the Klamath River. Adult mortality from ich and columnaris are not as common as juvenile mortality from *C. Shasta* or *Parvicapsula minibicornis*. Although fish disease mechanisms are poorly understood within the Klamath River basin, researchers believe modifications to the river's historical hydrologic regime have likely created instream conditions that favor disease proliferation and fish infection (Stocking and Bartholomew 2007). Since fine sediment routing from upstream sources is effectively blocked at each of Pacificorp's mainstem reservoirs, the river channel below Iron Gate Dam is currently comprised of an armored layer of course sediment incapable of mobilizing and redistributing during pulse flow events. As a result, whereas pulse flows of approximately 5300 cfs were likely sufficient to mobilize bedload in the Iron Gate Dam reach within a pre-dam Klamath River scenario, over twice that discharge (*i.e.*, 13,400 cfs) is now required to effectively mobilize and redistribute channel material (Hardy 2006). In response to the current environment of less winter pulse-flows, and therefore less frequent channel scouring events, a large, persistent community of rooted aquatic macrophytes have become entrenched throughout large stretches of the mainstem river channel between IGD and the Shasta River. Since a primary constituent (*Cladophora* spp.) of these macrophyte populations is the preferred habitat for the intermediate polychaete host of both *C. Shasta* and *P. Minibicornis*, the persistence of the macrophyte communities is increasing survival and production of the polychaete, which in turn is likely increasing the concentration of infective spores within the water column.

Less frequent fall pulse-flows may also affect disease transmission from adult salmon carcasses to the intermediate polychaete host. Under an unaltered hydrologic regime, fall and winter freshets help distribute salmon carcasses downstream into lower sections of the watershed, effectively dispersing nutrients, as well as infective spores that enter the aquatic environment as the carcass decomposes. The current flow regime does not effectively redistribute carcasses within the IGD to Shasta River reach, resulting in high densities of decomposing fish downstream of popular spawning areas, specifically the areas directly below Iron Gate Hatchery and the confluence of Bogus Creek and the Klamath River mainstem. Compounding the issue is the large number of returning adult salmon that congregate and spawn in areas adjacent to the hatchery, thus increasing carcass concentrations in the Iron Gate Hatchery (IGH) to Shasta River reach above natural levels. The high carcass densities have helped create areas where high spore loads from decomposing carcasses combine with an unchecked polychaete population. Researchers theorize that these areas represent “hot zones” where the rate and efficiency at which disease pathogens are transmitted from polychaete host to juvenile salmonids dramatically increase (Stocking and Bartholomew 2007).

An additive factor in potential infection rates includes the effect of water temperature. High water temperatures can stress adult salmon and slow upstream migration rates, facilitating the transmission of bacterial pathogens (e.g., *Ichthyopthirius multifilis* and *Flavobaterium columnares*) between healthy and sick fish as they crowd into the few cold water refugia areas of the lower Klamath River (USFWS 2003). High water temperature was one of several factors that likely contributed to a massive die-off of Klamath River salmon in 2002 – other factors include run timing, run size, habitat availability, and meteorological conditions (USFWS 2003). Of the over 34,000 fish estimated to have died during the event, approximately 344 were coho salmon (CDFG 2004).

Very little current or historical information exists to quantify changes in infection levels and mortality rates attributable to these diseases for salmonids. However, studies suggest that naturally spawned fish tend to be less susceptible to pathogens than hatchery-reared fish (Sanders et al. 1992).

### 4.6.7 Fish Harvest

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

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

Ocean exploitation rates have dropped substantially in response to the non-retention regulations put in place in 1994 as well as general reductions in Chinook-directed effort. Directed river harvest of coho salmon has not been allowed within the SONCC coho salmon ESU since 1994, with the exception of sanctioned tribal harvest for subsistence, ceremonial, and commercial purposes by the Yurok, Hoopa Valley, and Karuk tribes (CDFG 2002). SONCC-origin coho salmon that migrate north of Cape Blanco experience incidental mortality due to hooking and handling in this fishery; however, total incidental mortality from this fishery and Chinook-directed fisheries north of Humbug Mountain has been estimated to be less than 7 percent of the total mortality of coho salmon since 1999. In 2010 the estimated marine exploitation rate of California coho associated with the Chinook fishery is 2.2 percent (PFMC 2011b).

Since 1998, total fishery impacts have been limited to no more than 13 percent on Rogue/Klamath hatchery coho (surrogate stock) and no retention of coho in California ocean fisheries. Only marked hatchery coho salmon are allowed to be harvested in the Rogue and Klamath Rivers. All other recreational coho salmon fisheries in the Oregon portion of the ESU are closed.

Coho salmon harvested by Native American tribes are primarily incidental to larger Chinook salmon subsistence fisheries in the Klamath and Trinity Rivers. Tribal harvest is not likely a major factor for the decline of coho salmon. The Yurok fishery has been monitored since 1992 and during that time harvest has ranged from 27 to 1,168 fish caught annually. Based on estimates of upstream escapement (in-river spawners and hatchery returns) this fishery is thought to amount to an average harvest rate of 4.4 percent of Chinook for the period (CDFG 2004).

Harvest management practiced by tribes is conservative and has resulted in limited impacts on stocks.

Over-fishing in non-tribal fisheries is believed to have been a significant factor (62 FR 24588; May 6, 1997) in the decline of salmonids. Further, NMFS notes that under some circumstances, the impacts of recreational freshwater fishing are of concern - particularly during years of decreased availability of refugia, such as in drought years.

The commercial and recreational ocean fisheries for salmon and steelhead were closed in 2008 due to record low returns of Sacramento River fall-run Chinook salmon, and were extended through the 2009-2010 fishing season. The only exception to the 2009-2010 closure was a ten-day recreational ocean salmon season along the northern California coast targeting Klamath River fall-run Chinook salmon, due to projected spawner estimates surpassing conservation goals. In 2010, Klamath fall-run Chinook successfully exceeded the conservation objective of 35,000 naturally spawning adults, but the total in-river return of adults was still below the average for the years 1978-2010 (CDFG 2011).

In recent years, the commercial Chinook ocean fishery in California has been severely impacted due to low adult returns in the Sacramento and Klamath River systems. In 2010, California had its first commercial salmon fishery since 2007, although it remained heavily constrained by SRFC management objectives. In 2010, 216 vessels made salmon landings in California compared with zero vessels in 2008 and 2009. In 2007, there were 601 vessels active in California, compared with 477 vessels active in 2006 (PFMC, 2011b). The commercial salmon fleet in California is significantly reduced compared to fleet levels in the 1980's, prior to ESA listings of salmonids. The closure of the commercial and recreational fisheries is believed to decrease incidental take of listed salmonids, and therefore assist in their recovery.

### 4.6.8 Climate Change

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

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

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

### 4.6.9 Ocean Conditions

Variability in ocean productivity has been shown to affect fisheries production both positively and negatively (Chavez et al. 2003). Beamish and Bouillion (1993) showed a strong correlation between North Pacific salmon production and marine environmental factors from 1925 to 1989. Beamish et al. (1997a) noted decadal-scale changes in the production of Fraser River sockeye salmon that they attributed to changes in the productivity of the marine environment. Warm ocean regimes are characterized by lower ocean productivity (Behrenfeld et al. 2006, Wells et al. 2006), which may affect salmon by limiting the availability of nutrients regulating the food supply, thereby increasing competition for food (Beamish and Mahnken 2001). Data from across the range of coho salmon on the coast of California and Oregon reveal there was a 72 percent decline in returning adults in 2007/08 compared to the same cohort in 2004/05 (MacFarlane et al. 2008). The Wells Ocean Productivity Index, an accurate measure of Central California ocean productivity, revealed poor conditions during the spring and summer of 2006, when juvenile coho salmon and Chinook salmon from the 2004/05 spawn entered the ocean (McFarlane et al. 2008). Data gathered by NOAA suggests that strong upwelling in the spring of 2007 may have resulted in better ocean conditions for the 2007 coho salmon cohort (NOAA 2010). The quick response of salmonid populations to changes in ocean conditions (MacFarlane et al. 2008) strongly suggests that density dependent mortality of salmonids is a mechanism at work in the ocean (Beamish et al. 1997b, Levin et al. 2001).

### 4.6.10 Marine Derived Nutrients

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

# 5 ENVIRONMENTAL BASELINE

The environmental baseline includes "the past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process" (50 CFR § 402.02). The environmental baseline provides a reference point to which we add the effects of operating under the ITP as required by regulation ("effects of the action" 50 CFR 402.02).

For this analysis, the action area includes the Klamath River Management Unit and Scott Valley Management Unit, and the area one (1) mile downstream of the confluence of the Scott and Klamath Rivers. This delineation of action area is based upon the expected extent of habitat that could be directly or indirectly affected by the proposed action. Sedimentation as a result of implementation of the HCP from activities such as road building, road maintenance, and landslide activity is likely to have the most far-reaching effects on salmonid habitat; however because most of the HCP covered lands are in the upper portions of tributaries to the mainstem Klamath and Scott Rivers, sediment generated from the plan area is likely to be dispersed to such an extent that it no longer adversely affects salmonid habitat within one mile downstream of the action area (*i.e.*, the extent of any plan-related sediment "plume").

We refer the reader to the *Status of the Species* section for general information on the species' biology, ecology, status, and population trends at the species scale. We organized this section of the Opinion based upon the management units outlined in the HCP. The first part of each division section is a description and characterization of the current status of the species and proposed or designated critical habitat within that management unit. In order to understand the current stress regime that the listed species and their critical habitats are subjected to, the second part of each division section is a description of the factors affecting the covered species and their habitat in the action area.

## 5.1 Known Baseline Conditions within the Plan Area

### 5.1.1 Large Woody Debris

Site-specific riparian inventories have not been conducted along all streams in the action area. To provide a general indication of the condition of riparian stands, a FGS hydrology (stream) layer was buffered according to CDFG coho recovery plan specifications (150-foot buffers along Class I streams, 75- to 125-foot buffers along Class II streams, and 25- to 50-foot buffers along Class III streams) and overlain on the *FGS 2004 Forest Inventory* using a Geographic Information System (GIS). The range of buffer width within a given class was dependent on percent slope of adjacent hillsides. Results of this analysis are presented in Appendix A, which summarizes the number of trees per acre in various size classes in riparian stands along Class I, Class II, and Class III streams, respectively.

Site-specific information on riparian stands is available from inventories conducted on selected reaches within a few planning watersheds in the HCP area. Information on the number of trees per acre, basal area, quadratic mean diameter, and stream shading along these reaches is provided in Appendix A.

Stream inventories conducted in 1997 by FGS on West Fork Beaver Creek and West Fork Cottonwood Creek indicate approximately 3.8 pieces and 5.4 pieces of LWD greater than 12 inches in diameter per 1,000 lineal feet within the bankfull channel of these streams, respectively (FGS 2009). These levels are far below objective targets for LWD in Pacific Northwest forests (NMFS 1997) and are below the levels of LWD observed elsewhere in the Beaver Creek watershed. In the last two decades more than 300 instream structures, including log and boulder weirs, boulder clusters, mini debris jams, and woody channel margin structures have been placed in Beaver Creek, Cow Creek, and the West Fork of Beaver Creek (USFS 1996). Table 9 gives data on LWD levels found near or downstream of FGS property in the Klamath and Scott River watershed. It should be noted however that these LWD results are not unusual for managed commercial timberlands in the region of the action area.

**Table 9. Frequency and Characterization of Large Woody Debris near FGS lands in the Klamath River and Scott Valley Management Unit**

| Planning Watershed | Instream LWD Pieces/1,000 ft (Range)* | Average Diameter Inches (Range) | Average Length Feet (Range) |
|---|---|---|---|
| **Klamath River Management Unit** | | | |
| Beaver | 15.4 (1.8–28.9) | 13.3 (8.7–25.3) | 22 (16–27) |
| Cottonwood | 17.7 (1.8–22.1) | 9.6 (8.3–17.4) | 18 (17–21) |
| Doggett | 45.8 (27.4–67.8) | 13.2 (11.9–15.0) | 25 (22–30) |
| **Scott Valley Management Unit** | | | |
| Moffett | 7.3 (3.3–11.3) | 37.8 (13.0–62.8) | 17 (17–18) |

* LWD pieces included all wood > 4 inches in diameter

Source: FGS unpublished SCI data, 1997 to 2000

### 5.1.2 Water Temperature

In the action area, the Klamath and Scott rivers experience summer stream temperatures that exceed lethal limits for salmonids due to a combination of factors including reservoir operations, loss of riparian vegetation and the large surface area of the river subject to insolation. In this environment, the smaller tributaries are increasingly important as refugia habitat. Several of the smaller streams in the action area have stream temperatures that exceed optimal levels for salmonids, but may not necessarily be lethal.

FGS has collected water temperature data in streams throughout its Klamath River and Scott Valley Management Units since 1997. Table 10 depicts results from temperature recorders that have been typically placed where the stream leaves FGS lands. In West Fork Beaver Creek, a temperature recorder was also located where the stream enters FGS lands. These data provide the most complete record of water temperature conditions for streams in the HCP area. Based on the water temperatures recorded in the HCP area, in general, summertime temperatures do not commonly exceed lethal temperatures reported for anadromous salmonids. Overall, average summer water temperatures (MWATs and MWMTs) in monitored FGS streams are generally within the range considered suitable for juvenile rearing. Although stream temperatures in the immediate vicinity of the FGS ownership are generally within the range utilized by coho and Chinook salmon and steelhead, temperatures in much of the mainstem and lowermost portions of tributaries downstream of the HCP area in the Scott River Valley and Klamath River are not suitable for coho salmon (NCRWQCB 2005). For example, temperatures in lower Beaver Creek and West Fork Cottonwood Creek show summer temperatures that exceed suitability limits for juvenile coho salmon (see Table 10).

**Table 10. Water temperatures for select streams in the Action Area (temperatures above 16.8 degrees are generally considered lethal for coho salmon, and are noted in bold).**

| Stream (Planning Watershed) | Maximum Weekly Average Temperature [MWAT] Maximum Weekly Maximum Temperature (MWMT) (°C) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** |
| Bear Creek (Beaver) | ND | ND | 13.1 (14.6) | 14.5 (16.3) | 15.0 (16.4) | 14.9 (16.7) | 14.3 (16.2) | 13.7 (15.7) |
| ***Beaver Creek, mouth (Beaver)*** | ***ND*** | ***18.0 (20.9)*** | ***16.7 (19.5)*** | **19.0 (22.5)** | **20.4 (24.1)** | **18.8 (22.1)** | **19.2 (22.3)** | **18.6 (22.0)** |
| Doggett Creek (Doggett) | ND | ND | 14.7 (16.0) | 15.8 (17.2) | 17.6 (19.2) | 15.7 (17.1) | ND | 16.0 (17.4) |
| Hungry Creek (Beaver) | 13.2 (15.2) | 13.4 (15.1) | 12.9 (15.3) | 13.8 (15.8) | 13.9 (16.0) | 13.8 (15.9) | 14.3 (16.1) | 17.6 (20.6) |
| Kohl Creek (Dona) | 14.6 (16.5) | 16.3 (18.2) | 13.0 (14.2) | 14.7 (17.4) | ND | ND | ND | ND |
| ***Little Soda Creek (Beaver)*** | ***16.7 (18.9)*** | ***17.0 (18.9)*** | ND | ND | ND | ND | ND | ND |
| Meamber Creek (Meamber) | 15.7 (17.6) | ND | ND | ND | ND | ND | ND | ND |
| Middle Horse Creek (Horse) | ND | ND | ND | 15.3 (16.7) | 16.6 (18.1) | 15.3 (16.7) | ND | ND |
| ***Moffett Creek (Moffett)*** | ***16.9 (22.2)*** | ***16.8 (22.7)*** | ***15.8 (22.4)*** | **17.6 (23.6)** | **17.5 (20.6)** | ND | ND | ND |
| ***Sissel Gulch (Moffett)*** | ND | ND | ***16.3 (22.3)*** | **18.6 (24.0)** | **16.9 (24.3)*** | **17.9 (22.4)** | ND | ND |
| WF Beaver Creek, lower (Beaver) | 15.5 (17.8) | 15.3 (28.4)* | 13.8 (15.1) | 15.2 (16.8) | 16.1 (17.5) | 14.9 (16.7) | 15.6 (17.2) | 15.0 (16.8) |
| WF Beaver Creek, upper (Beaver) | 14.3 (16.8) | 13.8 (15.8) | 12.7 (14.3) | 13.6 (16.1) | 15.7 (18.1) | 14.1 (16.9) | ND | ND |
| ***WF Cottonwood Creek (Cottonwood)*** | **17.4 (20.7)** | **17.1 (20.0)** | **15.2 (18.4)** | **18.8 (22.4)** | **ND** | **19.1 (27.6)*** | ND | ND |

* Temperature Data Recorder may have been dewatered at some time. ND: no data

## 5.2 Status of the Species and Critical Habitat in Klamath Management Unit

### 5.2.1 SONCC Coho Salmon

*Distribution*

Current survey information on the distribution of coho salmon in the Klamath River within the action area is limited; however, juvenile coho have been observed in Beaver Creek (Miller et *al.* 1993) and lower Cottonwood Creek (USFS 1993), several miles downstream of FGS lands. The dam at Iron Gate blocks approximately 48 km of coho habitat in the Upper Klamath River population unit (Hamilton et al. 2005). In the Upper Klamath population which extends from Portugese Creek to blocked access at IGD, coho are believed to sporadically utilize the lower reaches of Seiad Creek, Grider Creek, Horse Creek, Empire Creek, Walker Creek, Dutch Creek, Humbug Creek, Hornbrook Creek, and West Fork Beaver Creek (NMFS, unpublished data) although documentation of spawning and rearing in these tributaries is not consistent. It is likely that during favorable water years, coho juveniles may utilize the lower reaches of cool water tributaries to the Klamath River. Immediately downstream of IGD, coho are known to fairly consistently occupy Bogus Creek at locations several miles downstream of the HCP area. The Shasta River maintains a separate independent population of coho, but as mentioned Shasta River fish are not expected to be affected in any significant degree by the implementation of the HCP.

*Abundance and Productivity*

Limited information exists regarding SONCC coho salmon abundance in the Klamath River Basin. Good et al. (2005) summarized available historic population data for the Klamath and Scott Rivers. More recent observations of juvenile outmigrant abundance (USFWS 2001) and spawner surveys indicate persistently low abundance of coho salmon in the action area. Ackerman et al. (2006) estimated adult run sizes in the Klamath Basin. Table 11 is the run size estimates for the Klamath Basin excerpted from Ackerman et al. (2006).

**Table 11. Approximate run sizes of naturally produced coho salmon to various reaches within the Klamath Basin, 2001-2004 (Values are approximate; from Ackerman et al. 2006)**

| Reach | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|
| IGH | 200 | 200 | 600 | 400 |
| Upper Mainstem | 100 | 100 | 100 | 100 |
| Shasta | 200 | 100 | 200 | 400 |
| Scott | 1,000-4,000 | 10-50 | 10-50 | 2,000-3,000 |
| Up Misc Tribs | 1,500 | 500-1,500 | 1,000-4,000 | 2,500 |
| Mid Mainstem | 0 | 0 | 0 | 0 |
| Salmon | 50 | 50 | 50 | 50 |
| Mid Misc Tribs | 300-700 | 0-500 | 300-700 | 1,000-1,500 |
| Lower Mainstem | 0 | 0 | 0 | 0 |
| Trinity | 3,000 | 500 | 4,000 | 9,000 |
| Low Misc Tribs | 500 | 0 | 400-800 | 1,000-2,000 |
| **Total** | **7,000 – 10,000** | **1,500 – 3,000** | **7,000 - 11,000** | **16,000 - 19,000** |

Recent work by the SONCC coho salmon Technical Recovery Team (Williams et al. 2008) suggested that on the order of 8,500 (Upper Klamath River population), 3,900 (Middle Klamath River) and 10,600 adults (Shasta River) should be returning to spawn in each of the three historic population units for these populations to achieve viable (low risk) abundance levels. Furthermore, population depensation thresholds range from 425 (Upper Klamath River), 113

(Middle Klamath River), to 531 (Shasta River). The middle Klamath River population unit covers the area from the Trinity River confluence upstream to Portuguese Creek (approximately the downstream extent of the action area). Adult spawning surveys and snorkel surveys have been conducted by the U.S. Forest Service and Karuk Tribe, but data from those efforts are insufficient to draw conclusions on run sizes (Ackerman et al. 2006). Ackerman et al. (2006) relied on professional judgment of local biologists to determine what run sizes would be in high, moderate, and low return years to these tributaries. In each of the four years presented by Ackerman et al. (2006) the run size approximations fall below the low risk targets outlined in Williams et al. (2008). Given the current numbers of fish observed in the limited survey data available and run size estimates given by Ackerman et al. (2006), current natural coho salmon abundance levels in the Middle and Upper Klamath Basin Population Units are far below low risk viability targets and may currently be at or approaching depensation thresholds (NMFS, unpublished data). Fish counts at the Shasta River fish counting facility documented nine (9) coho, all males, returning to the Shasta in 2009 (Pisano 2009). Fish counts in the 2010/11 run year counted a net total of 44 coho adults in the Shasta River (Chesney and Knechtle 2011).

*Diversity*

Research by the Yurok and Karuk Tribes, plus research from outside the Klamath Basin, indicate that coho salmon in the Klamath River probably exhibit a diversity of early life history strategies, utilizing the mainstem Klamath River throughout various parts of the year as both a migration corridor and a rearing zone. In several different years, personnel from CDFG noticed a distinct emigration of sub-yearling (≤1 year of age) smolts around mid-May on the Shasta River. Analysis of scale samples from all years indicates that most of these fish are less than one-year old (USDI BOR 2007).

*Summary*

In summary, information on SONCC coho salmon population status in the action area is limited, but what information exists suggests that these populations are currently not viable due to a combination of low abundance and productivity, limited spatial distribution and hatchery influences.

### 5.2.2 SONCC Coho Critical Habitat

Within the action area, the essential habitat types of SONCC coho salmon designated critical habitat include the following; (1) juvenile summer and winter rearing areas, (2) juvenile migration corridors; (3) adult migration corridors; and (4) spawning areas. No marine or estuarine habitat occurs within the action area. Within the Klamath Management Unit, essential features of critical habitat include adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions (64 FR 24049). Within this area, water quality and quantity conditions, affected by dam operations in the Upper Klamath, impede the proper function of the mainstem Klamath. Due to the low flow conditions caused by operations of the dams and hydro-electric facilities upstream, mainstem water temperatures are often elevated in late summer, early fall.

As mentioned previously, only 3.7 miles of drainages on FGS lands in the Klamath Management Unit are known to support SONCC coho which includes 2.2 miles in the Beaver Creek drainage, and 1.5 miles in Empire Creek. Bogus Creek, which lies within the Klamath River Basin, is an important tributary for coho, but coho distribution lies several miles below FGS lands. Horse Creek is also known to support coho, but FGS does not own land that overlaps Horse Creek although their operations could affect it. Other tributaries that receive drainage from FGS lands in the Middle Klamath Unit are not suspected to support coho habitat, but could have the potential to influence mainstem habitat through surface water and sediment influx.

Summertime temperature monitoring of MWAT on West Fork Beaver Creek and Horse Creek, which include a large proportion of FGS lands, have historically been within suitable ranges for coho survival (FGS, unpublished data). Data gathered on pool frequency and depths in West Fork Beaver Creek, Cottonwood Creek, and Doggett Creek indicate relatively shallow and infrequent pools (FGS, unpublished data). Sediment data collected in the Klamath Unit indicate fine sediment may be elevated in Cottonwood and Doggett Creeks impacting salmonid spawning success, however coho are not known to currently utilize FGS lands in these two watersheds. Data on LWD levels indicate insufficient LWD in Beaver, Cottonwood, and Doggett Creeks. In Beaver Creek FGS has been involved in numerous projects placing LWD in streams however, not all these structures have remained in place, and lack of suitable LWD may be limiting coho production in this important tributary.

A permanent diversion consisting of a flashboard dam and fish ladder was built by CDFG in 1983 on Cottonwood Creek, replacing a temporary gravel structure built annually by a private landowner for agricultural diversion. While the new structure functions to provide fish passage, there is little control of flows through the center ladder. Water levels permitting, all species of anadromous salmonids have passage; however, springtime installation of the flashboards and agricultural diversion can result in dewatering of the stream below the dam. The DFG conducts salvage operations above the dam to transport smolts to the Klamath River. FGS has replaced a number of flashboard dams on West Fork Cottonwood Creek with ladder structures to provide access to 2.2 miles of summer rearing habitat in this drainage.

### 5.2.3 Klamath and Trinity Rivers Chinook Salmon

<u>Distribution</u>

In addition to the mainstem Klamath River, other streams in the action area that support Chinook salmon are Seiad Creek, Beaver Creek, Horse Creek, Bogus Creek and possibly Cottonwood Creek, as the USFS has observed Chinook salmon fry in lower Cottonwood Creek (USFS 1993). Iron Gate Dam prevents Chinook salmon from accessing hundreds of miles of their historic habitat.

In Beaver Creek, fall-run Chinook salmon spawning occurs along the lower 7.7 miles of the mainstem (Olson and Dix 1992); most spawning occurs between the Beaver Creek Campground and the confluence with the Klamath River (USFS 1996). The U.S. Forest Service has modified a barrier on Horse Creek near the confluence with Middle Creek. The original structure (an earthen dam) blocked passage for Chinook salmon, but coho salmon and steelhead were able to pass when the structure "blew out" during high water in the winter. The earthen dam has been replaced with a boulder weir structure to allow passage. Providing passage opens approximately 13 miles of additional Chinook salmon habitat, and fall-run Chinook salmon have been observed passing through the structure (Flosi pers comm. 2011).

*Abundance and Productivity*

High levels of hatchery production as previously discussed confound any abundance and productivity estimates for naturally-produced Chinook salmon in this management unit. Escapement estimates for the fall-run Chinook salmon in the Upper Klamath population range from the low teens or hundreds for Beaver and Horse Creek, to approximately 6,000-35,000 for Bogus Creek (KRTT 2010). The Bogus Creek population may be the most heavily influenced by returning hatchery fish to Iron Gate Dam, as the tributary is located directly downstream of the dam. The loss of habitat access and reductions in habitat quality in reaches currently accessible to Chinook salmon would suggest that abundance and productivity are reduced.

*Diversity*

Historically, large runs of spring-run Chinook were present in the Klamath River Basin, outnumbering fall-run by large margins. However, overfishing and habitat destruction nearly extirpated spring-run Chinook by the early 1900s (Leidy and Leidy 1984). Fall-run Chinook are now the most numerous in the Upper Klamath Population and the action area. Due to the long history of high release numbers from the IGD hatchery and records of hatchery straying into basin tributaries it is likely that the “purity” of naturally reproducing stocks has been negatively impacted.

*Summary*

Specific viability criteria have not been developed for the Upper Klamath-Trinity Chinook salmon ESU. However, information from the action area suggests that populations in the action area are at risk due to reduced spatial distribution, decreased abundance and productivity, and interactions of hatchery and wild fish.

### 5.2.4 Klamath Mountains Province Steelhead

*Distribution*

Winter steelhead are probably the most widely distributed of the salmonid runs in the action area because their return timing may allow them access to many of the smaller streams. Summer steelhead return to several tributaries in the Klamath River Basin, and adults have been observed holding in lower Cottonwood Creek during the summer (USFS 1993). However, streams in the action area do not support consistent numbers of returning summer adults.

*Abundance and Productivity*

Abundance and productivity estimates for steelhead in the Upper Klamath Population in the action area are not available. Furthermore, any estimates of abundance and productivity are confounded by the difficulties in sampling winter-run adults and the contribution of hatchery fish to naturally spawning escapements. The most representative information is that discussed in the *Status of the Species* section where recent trends in abundance have been mixed. Steelhead abundance in the Upper Klamath is of sufficient size to support a recreational in-river hatchery origin fishery, but abundance is believed to be depressed compared to historical levels. Since the

1990s, returns of steelhead adults to the IGD has averaged around 500 individuals, with an average release of steelhead yearlings from the hatchery of around 200,000 (Israel 2003).

*Diversity*

Summer steelhead are noted as an important diversity component of this ESU. The ESU, as a whole contains "an unusual richness" of summer steelhead populations compared to other coastal steelhead ESUs. This diversity is represented in the Klamath Management Unit, although little information on historical characteristics of summer steelhead in the region is available. The West Coast Steelhead Biological Review Team (BRT 2001) noted that summer steelhead populations appear to be relatively stable, but current abundance levels are likely well below historic levels and steep declines were noted up to the 1980s. The BRT (2001) expressed serious concern over the status of summer steelhead populations in the ESU.

*Summary*

Specific viability criteria have not been developed for the Klamath Mountains Province steelhead ESU. Information indicates that populations in the action area may be depressed compared to historical levels but do not appear to be at risk of low viability due to reduced spatial distribution, abundance and productivity, and interactions of hatchery and wild fish.

## 5.3 Status of the Species and Critical Habitat in the Scott Valley Management Unit and Downstream Confluence with the Klamath River

### 5.3.1 SONCC Coho Salmon

The low-gradient setting of the Scott Valley likely provided extensive habitat for coho salmon spawning and rearing (Williams et al. 2006). Coho salmon have been observed in several tributaries of the Scott River (e.g., USFS unpublished data, Hassler et al. 1991, West et al. 1990, DFG 1994, Maurer 2002, Maurer 2003, SRCD 2004, SRCD 2005) and, historically, were likely much more widely distributed than current conditions.

Ackerman et al. (2006) estimated run size for the Scott River population unit of anywhere between 10 to 4,000 spawners between the years 2001-2004 with one strong and two weak cohorts (see Table 11). The variation in estimates could be due to variable rates in effort and differences in survey conditions between years, or variation in cohort strength. There is also a current lack of understanding of mainstem coho spawning which may affect estimates. Adult carcass counts at the Scott River weir for 2007 and 2008 were 130 and 4 respectively, indicating the likelihood of an extremely low run of at least two of three cohorts in the Scott River population. Approximately 81 fish were counted in the 2009 run (Pisano 2009). CDFG estimated the total number of coho salmon that entered the Scott River during the 2010 season to be 927 (Knechtle and Chesney 2011) representing a significantly higher than average return for the past few years. However, the run size estimates are far below the low risk threshold provided in Williams et al. (2008) of 8,800 spawners, again calling into question the long-term viability of this population unit.

### 5.3.2 SONCC Coho Critical Habitat

Within the Scott Valley Management Unit of the action area, essential features of critical habitat include adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions (64 FR 24049). Within this area water quality and quantity conditions, affected by instream water withdrawals for agricultural and domestic uses, impede the proper function of the Scott River and its significant tributaries. These diversions substantially reduce stream flow in the lower portions of the tributaries during the summer through the fall period, resulting in dewatering of sections of many streams (e.g., Etna, Patterson, Kidder, Moffett, Shackleford, and Mill creeks). In prolonged droughts, portions of the mainstem Scott River can be completely dry. Such extreme low flow can lead to drying of refugia pools and blockage or delay of adult migration into the mainstem and larger tributaries.

Within the plan area, FGS lands are in close proximity to approximately 6 miles of coho habitat near the Meamber Creek drainage and the mainstem Scott River. Surface water temperature monitoring of Meamber Creek for MWAT indicate water temperatures are within the range of suitability for coho survival. Other drainages where FGS owns property tracks where coho are known to be occasionally present include Moffett Creek (up to McAdams Creek), East Fork Scott River, Mill Creek, and Pat Ford Creek (FGS unpublished data). It is likely that Moffet Creek, being a sizeable drainage, is more likely to support coho on a more frequent basis than the small tributaries. Surface water temperature data indicated Moffett Creek maintains suitable temperatures for coho survival (FGS unpublished data). Surveys on pool characteristics in Moffet Creek indicate higher frequency of pools but shallower pools than that found in Klamath drainages containing lands managed by FGS (FGS unpublished data). Limited data on substrate composition in Moffet Creek indicate fine sediment may be elevated and potentially impacting successful spawning.

### 5.3.3 Klamath and Trinity Rivers Chinook Salmon

*Distribution*

Most Chinook salmon spawning in the Scott River Basin appears to be in the mainstem Scott River (Olson and Dix 1992, DesLaurier 1993) and generally occurs up to the first 20 miles of river reach. Beyond this distance pools are usually too shallow or the river is dry during spawning periods. Spawning activity in tributaries is often limited due to low flow levels in the fall that restrict access to spawning sites (Olson and Dix 1992, DesLaurier 1993). Spawning in lower reach larger tributaries may occur occasionally during years with high and early fall rain events.

*Abundance and Productivity*

Fall-run Chinook salmon are now the most numerous of the Chinook salmon runs in the action area. From 1998-2002 adult redd counts have averaged around 1,000 in the Scott River Basin with an escapement estimate for the same time period around 5,000 adults (CDFG 2002). CDFG estimated the total number of Chinook salmon that entered the Scott River during the 2010 season to be 2,508 fish representing a higher than average return (Knechtle and Chesney 2011).

*Diversity*

According to Moyle (2002) spring-run Chinook salmon in the Scott River were extirpated by the 1970s. Diversity is also likely influenced by occasional straying of IGD hatchery produced fall-run Chinook salmon into the Scott River naturally spawning population, although the degree of the effect on diversity is not known. Straying of hatchery produced adults has likely occurred since fall-run Chinook salmon began being released in the 1960s.

*Summary*

Specific viability criteria have not been developed for the Klamath and Trinity Rivers Chinook ESU, which includes the Scott River population. Information indicates that populations in the action area are depressed compared to historical levels but do not appear to be at risk of low viability due to reduced spatial distribution, abundance and productivity, and interactions of hatchery and wild fish.

### 5.3.4 Klamath Mountains Province Steelhead

*Distribution, Abundance and Productivity*

In the Scott River, Olson and Dix (1992) noted that the lower reaches of Shackleford and Mill creeks (downstream of FGS lands) have spawning habitat for a large number of steelhead and suggested that these creeks served as "spawning refugia" for steelhead displaced from other portions of the Scott River Basin. Kidder Creek was noted as containing excellent spawning gravel (SRCD 1997).

Considerably more information is available on the distribution of juvenile steelhead. Juveniles have been observed in numerous tributary streams throughout the middle Klamath and Scott River basins (FGS unpublished data, USFS 1996, USFS 1993), as well as in the mainstem (Belchik 1997). West et al. (1990) reported "high densities" of juvenile steelhead in the lower reaches of Mill Creek. Steelhead have a fairly wide distribution in the Scott River Basin; however, the composition of the steelhead populations in tributary streams in terms of hatchery and naturally produced fish is unknown. Within lands covered in the HCP area in the Scott River Basin, steelhead are found in Moffett Creek, McAdams Creek, Mill Creek, Pat Ford Creek, Indian Creek, and East Fork Scott River (Bull 2010). As mentioned previously, abundance estimates for steelhead in the Klamath River Basin, including the Scott River Basin is not well understood.

*Diversity*

Pearse et al. (2007) found that hatchery steelhead adults sampled from Iron Gate Hatchery in 2001 were genetically similar to smolts sampled by screw trap in the Shasta and Scott Rivers, suggesting that significant gene flow has occurred between IGD produced fish and these systems, presumably due to straying of returning hatchery adults.

*Summary*

Specific viability criteria have not been developed for the Klamath Mountains Province steelhead ESU, which includes the Scott River population. Information indicates that populations in the action area may be depressed compared to historical levels but do not appear to be at risk of low viability due to reduced spatial distribution, abundance and productivity, and interactions of hatchery and wild fish.

## 5.4 Factors Affecting SONCC coho, Klamath and Trinity Rivers Chinook, and KMP Steelhead and their Habitat in the Action Area

### 5.4.1 Dams and Diversions

Flows in the Klamath River are regulated by the operation of several hydroelectric dams in the upper watershed (the Klamath Project). The Klamath Project slows water by capturing and storing it in lakes and shallow canals, which contributes to increased water temperatures in the Klamath River, particularly during summer months. The Klamath Project also increases nutrient levels in the system due to the addition of agricultural return water which may exacerbate naturally occurring summertime growth of algae in the mainstem and lower tributaries. Finally, Klamath Project dams are total barriers to anadromous fish passage into and out of the Upper Klamath Basin, including areas historically accessible to SONCC coho salmon that is at least 48 km in length (Hamilton et al. 2005).

Historically, large runs of spring-run Chinook salmon were present in the Klamath River Basin, outnumbering fall-run Chinook salmon stocks substantially with the Scott and Shasta Rivers being major producers of the spring-run (Snyder 1931). Overfishing and widespread habitat destruction nearly extirpated this run in the early 1900s (Leidy and Leidy 1984). At the time that Iron Gate Hatchery operations began (1962), a few spring-run Chinook salmon were still returning to the upper Klamath River.

Anadromous salmonids, especially coho salmon, have experienced pronounced changes in the hydrologic conditions of the Klamath River to which they were once adapted. Aquatic species (like coho salmon) have evolved life history strategies in direct response to natural flow regimes (Taylor 1991, Bunn and Arthington 2002, CETFKRB NRC 2004). Streams in the action area have been extensively modified by levees, dikes, dams, and the draining of wetlands since efforts began in 1905 to improve the ability of the region to support agriculture (the Klamath Project; NRC 2007). These dams and diversions blocked salmon and steelhead from more than 200 miles of spawning and rearing habitat along Klamath River tributaries (CDWR 1965). Unscreened or poorly screened water diversions and ditches resulted in a significant loss of juvenile fish, which Taft and Shapovalov (1935) reported as the “most serious present loss of trout and salmon.” During a review of Klamath River ditches, most were found to contain juvenile fish (Taft and Shapovalov 1935). The change to the hydrological regime of the mainstem Klamath River has been a loss of flow variability, a reduction in the recruitment of mainstem spawning gravels, a reduction in base flows throughout the year, most pronounced in the spring and summer months, earlier minimum summer flows, earlier peak spring discharges, and a reduction in magnitude of peak spring discharge.

These changes to the hydrologic regime are not limited to the mainstem Klamath River. Numerous agricultural diversions in the Scott River, as well as other tributaries to the Klamath River, have altered streamflow patterns to such an extent that seasonal movements of fish are limited, particularly in the summer months when stream flows are low and consumptive and agricultural water demands are high. Since the 1970s, stream dewatering has been a persistent problem in the Scott River basin (West et al. 1990, SRCD 1997, NCRWQCB 2005) and may strand thousands of juvenile salmon and steelhead each year (SRCD 1997). There are several smaller impoundments in the action area that create barriers to fish migration. On the Scott River, Young's Dam agricultural diversion dam previously hindered fish passage at high and low flows, but a fish-way and rock-weir structure were installed in 2006 to ensure fish passage above Young's Dam. Big Mill Creek, a tributary to the East Fork Scott River, has a fish passage barrier caused by down cutting at a road culvert outfall. Rail Creek, another tributary to the East Fork Scott River, has a fish passage barrier and impoundment caused by an irrigation pond levee. A project to provide fish passage at Rail Creek has been designed and has recently obtained implementation funding.

In an early survey of diversions in the Klamath Basin, the Scott River was reported to have 70 diversions, most of which were unscreened (Taft and Shapovalov 1935). Many other diversions, screened and unscreened, were located in tributaries of the Klamath and Scott Rivers. Early fish habitat surveys in the basin noted that the vast majority of screened diversions needed repair (Taft and Shapovalov 1935).

The state began efforts to screen the diversions in Scott Valley as early as the 1930s. A permanent program was initiated in the 1970s with the establishment of an improved DFG Stream Improvement Headquarters established in Yreka. The DFG constructed 30 fish screens in the Scott River watershed on important diversions from the 1970s through the mid-1990s (SRCD 2005). In addition to DFG's efforts, the Siskiyou Resource Conservation District (RCD) has installed a total of 55 fish screens. Combined with the 30 fish screens the DFG constructed and maintains, 85 of the estimated 120 active diversions are screened (SRCD 2005). An estimated 20 active diversions remain unscreened in the uppermost portions in the watershed. All but seven diversions within the known distribution of anadromous salmonids are now screened, and three of these seven are of low priority. All diversions within the known Chinook salmon distribution are screened, and a significant number of the unscreened diversions are outside of the known steelhead distribution (SRCD 2005). All fish screens constructed by the Siskiyou RCD meet federal and state screening criteria. These long-term screening efforts are believed to have reduced rates of mortality on juvenile covered species from screen impingement and intake of juveniles into pumped distribution systems. Other factors in juvenile mortality (e.g., stream dewatering) have not been properly addressed however, and constitute a significant mortality factor in the Scott River population.

### 5.4.2 Timber Harvesting

To access the developing resources in Northern California and finance construction of a railway, much of the land in the Klamath Basin was deeded to railroads in a checkerboard pattern (every other section of land). As the railroads sold or traded this land to finance their operations, small sawmill operations began producing milled wood. Local sawmills supplied miners with wood used to construct housing and flumes. Lumber was later supplied to shore up tunnels and construct stamp mills (USFS 1996).

Early logging operations used steam donkeys, log chutes, horses, and oxen to typically access trees in riparian areas and to transport logs. Yarding was typically conducted in a downhill direction, towards the mills located along the streams. Steam donkeys were eventually replaced with steam engines and railroad track, allowing logs to be transported longer distances and in greater quantities. By the late 1930s and 1940s, railroad logging declined and railroad grades were often converted to road systems for logging trucks. More modern yarding techniques developed, allowing logs to be yarded uphill away from streams to landings located higher on the hill slope. Extensive new road development and reconstruction of existing roads, which included the installation of numerous water crossings, began in the late 1950s and continued to the mid-1980s by private timber companies and the USFS, primarily for the purpose of timber harvest. Early logging practices often resulted in significant impacts to salmonid streams as riparian buffers were practically non-existent, trees were often yarded through stream corridors, and transportation systems were built without regard to landslide hazards, or proper stream functioning (e.g. undersized stream crossings prone to washout) (Murphy 1995; Bjornn and Reiser 1991).

Through 1971, most timber harvest occurred in old-growth stands. Snag removal and stream cleaning were common harvest practices. Large sugar pine and ponderosa pine were the preferred logs because they were easy to mill, and mills were designed to accommodate logs over 20 inches in diameter. Intensive timber harvest began in the 1950s as mills were refurbished to cut dimensional lumber and fir trees became desirable as a post WWII housing boom began. Overstory removal was the dominant regeneration harvest method. During the 1960s, clear-cutting became the dominant harvest method, and many plantations (monoculture stands) were established on the KNF until about 1990. Since passage of the California Forest Practices Act (CFPA) in 1973, timber management has focused on younger, more productive forests. Mandatory protective measures for natural resources have been implemented, including designated stream protection zones, canopy retention standards, stream crossing standards, and other protective best management practices. With the implementation of the CFPA, trees in riparian areas have become reestablished and generally provide adequate and increasing amounts of shade to streams. Recruitment of adequate LWD to streams, however, has not yet recovered as large wood was removed from riparian areas during early logging cycles and many riparian areas were colonized by poor LWD species such as hardwoods. In addition, conifers do not typically grow to a suitable size for long-term LWD stability until 80-100 years.

Timber harvesting in the action area has had a long-lasting effect on fish habitat conditions. Most notably, harvest of streamside trees during the early and middle 1900s has left a legacy of reduced LWD recruitment and contributed to elevated stream temperatures, particularly along the Klamath mainstem and along the lower reaches of the Scott River. Sedimentation from modern-day harvest units, harvest-related landslides and an extensive road network continues to impact habitat although at much reduced levels as compared to early logging. Ground disturbance, compaction, and vegetation removal during timber harvest has modified drainage patterns and surface runoff resulting in increased peak storm flows which has increased occurrences of channel simplification and channel aggradation (Bjornn and Reiser 1991). Simplification of stream channels and sediment aggradation results in loss or destruction of salmonid habitat as pool complexes and side channel winter rearing habitat are often lost or degraded to such an extent as to no longer provide refugia for developing juveniles.

### 5.4.3 Roads

Road construction and maintenance associated with timber harvesting activities is well recognized as a significant impact to salmonids due to its role in increasing peak flow discharge and channel scour from increases in surface flow, and large-scale inputs of road related sediment to watercourses.  Roads in the action area are not limited to timber harvesting alone as they are also used for recreational uses on public lands.  Since 1994, an emphasis on timber harvest and associated road construction on Federal lands has given way to aquatic habitat management and restoration through implementation of the Northwest Forest Plan (NWFP).  The NWFP was established, in part, to maintain and restore the ecological health of watersheds and aquatic systems damaged from historical management practices.  Following this guidance has resulted in the decommissioning of 167 miles of KNF system roads and 75 miles of road rehabilitation over the past decade or so (USFS 2010).

A summary of first-year erosion delivered to streams from stream crossing/near channel construction and road decommissioning (USFS 2003) indicates that existing roads contribute to the majority of current accelerated erosion, while erosion from non-road activities has diminished.  In the absence of road maintenance, drainage structures become clogged and bypassed, resulting in road damage, surface erosion, and mass wasting that deliver both suspended sediment and bedload to fish habitat downstream.  A preliminary 10-year assessment of the condition of watersheds within the NWFP area (Reeves et al. 2006) concluded that nine times more roads were decommissioned from 1994 to 2003 than were constructed, with decommissioning priorities often focused on those roads contributing or at risk of contributing the highest amounts of sediment to important aquatic habitats.  Reeves et al. (2006) concluded that removing road-stream crossings in riparian zones can have a positive effect on watershed condition by reducing sediment mobilization to streams.  The KNF has implemented road maintenance, road closures, and road decommissioning projects to reduce road-related erosion on KNF-managed lands.  These on-going road restoration efforts are expected to decrease sediment input from road sources in the future (Madej 2001, USFS 2010), and improve aquatic habitat conditions, including substrate, spawning gravel quality, and pool depth.

### 5.4.4 Mining

With the discovery of gold at Scott Bar (Siskiyou County) in 1850, communities quickly established as prospective miners rushed to make their fortune.  Mining claims were established along the Klamath and Scott Rivers.  These claims were categorized into river, bank, gulch, or hillside claims.  The initial and cheapest method to recover gold was placer mining.  Through extensive systems of wing dams, ditches, sluices, and long-toms, early miners were able to divert the river to extract gold from the old gravel beds and benches.  Hydraulic mining began in the area sometime after 1850, and operations were often concurrent with hard-rock and dredge mining.  Giant “monitors” were used to wash away entire hillsides.  This form of mining may have existed into the 1930s along with dredge and small-scale, depression-era placer mining. Large-scale dredge mining, however, continued in the upper reaches and tributaries of the Scott River until the 1950s (Sommarstrom et al. 1990).

Gold mining within the Klamath and Scott watersheds was the primary resource for extraction from the mid-1850s through the 1930s.  Mining was very destructive to fish habitat in the lower Klamath basin in the 1800s (CETFKRB NRC 2004).  Hydraulic mining diverted creeks to supply water to high pressure nozzles that leveled entire hillsides and rearranged much of the riparian areas in the basin.  Waterborne soil, rocks, minerals, and debris were directed into sluices containing mercury which extracted the gold.  Sluicing and hydraulic mining operations increased turbidity and siltation, which adversely affected benthic invertebrates, smothered salmon redds, destroyed riparian areas, and filled pools with sediment. Deforestation associated with mining destabilized hillslopes, increased erosion, flooding, and fires. Miners also directly impacted aquatic resources through overfishing, damming, and stream diversions (Malouf and Findlay 1986).

Mining activities in the 1800s caused extensive changes to the Scott Basin, including the main stem, South Fork, Oro Fino, Shackleford, and French creeks (CETFKRB NRC 2004). Yuba dredges caused some of the most visible damage to the basin from 1934 to 1950 (Sommerstrom et al. 1990). Taft and Shapovalov (1935) identified severe damage to fish habitat caused by Yuba dredges, which usually left the coarsest boulders on the surface of the streambed, armoring the finer sediments underneath (CETFKRB NRC 2004). Ditches that intercepted tributary flows were also constructed throughout the valley to support mining operations and early agricultural irrigation (CETFKRB NRC 2004).

Mercury, which was used to extract gold, was released into the environment. Methyl-mercury can travel through the food chain into fish, and could be a danger to humans who eat fish in the area (CETFKRB NRC 2004). Juvenile coho salmon may be sensitive to methyl-mercury, and early life stages may be adversely affected by low concentrations of methyl-mercury and other mining contaminants although the effects of residual mercury levels on salmonids in the Klamath Basin has not been extensively studied ( Buhl and Hamilton 1991; Devlin and Mottet 1992; Buhl and Hamilton 1990).

Riparian areas across the action area were disturbed by the mining of alluvial deposits using panning, sluicing, or dredging (*i.e.*, placer mining) starting in 1850. Hydraulic mining, using pressurized water, later became common along streams, and continued beyond the 1930s (USFS 2000). In many locations, especially along the Scott River, large areas were stripped of vegetation and the stream deposits hydraulically or mechanically worked to retrieve deposited gold. These activities left a legacy of unvegetated, heavily disturbed river deposits mostly devoid of soil. Taft and Shapovalov (1935) found that silt from mining was reducing aquatic food organisms. Placer mining has resulted in loss of habitat for all freshwater life history stages of anadromous fish. Hydraulic mining ended around 1950, but many riparian areas on the Scott River contain large remnant alluvial deposits of mine tailings, and remain poorly vegetated and erodible up to the present day (USFS 2000). Limited placer, hard rock, and suction dredge mining continue to occur today (USFS 2010).

### 5.4.5 Grazing

Domestic livestock were brought to Northern California over 150 years ago. Miners and homesteaders raised livestock to supply food for local residents and for transportation to distant markets. As the Scott Valley area became settled and ranches were established, cattle and sheep were moved into the adjacent mountains to forage. In the early 1900s, grazing was largely unregulated, and livestock numbers were as much as five times higher than what is currently permitted on the Klamath National Forest (USFS 1996, 2000, 2002). In the past, the longer grazing seasons of February through December (compared to the present April to October grazing season) allowed animals to graze plants in the more sensitive times of spring and early winter. Livestock often grazed in riparian areas resulting in sediment and organic pollution of adjacent watercourses, and overgrazing can contribute to landslide events. Continued high use of the mountain rangelands created degraded conditions in some areas, and forage production was reduced. The land affected by grazing today is a much smaller portion of the Klamath

National Forest (USFS 1996, 2000, 2002). The Klamath National Forest allocates 82,900 acres to winter range, which includes range for livestock, big game such as deer and elk, as well as for wild horses (KNF 2010). In terms of livestock grazing allotments within winter range habitat, there are 60 range allotments with 70 permittees (KNF 2010). Grazing in the action area is expected to continue in a fashion similar to current conditions into the foreseeable future.

### 5.4.6 Agriculture

Agriculture is the major land use within the Scott Valley (Gwynne 1993). Cattle production is a prominent feature of the valley landscape, with livestock sometimes having unlimited access to the river channel (Gwynne 1993). Water diversions for agriculture, flood control, and residential/domestic use have greatly reduced or eliminated historically accessible SONCC coho salmon habitat in the Scott River valley. In general, in combination with other land management activities these types of historic agricultural practices have (USFS 2000):

- Reduced connectivity between streams, riparian areas, flood plains, and uplands;
- Significantly increased sediment yields, leading to pool filling and reduction in spawning and rearing habitat;
- Reduced or eliminated instream replenishment of LWD, which serves to trap sediment, stabilize streambanks, form pools, and provide cover;
- Reduced or eliminated riparian forest canopy that minimizes water temperature fluctuations;
- Reduced stream complexity by causing streams to become straighter, wider, and shallower, which in turn reduces spawning and rearing habitat and increases water temperature fluctuations;
- Altered peak flow volume and timing; and
- Altered water tables and base flow

Recent increases in water use in the Scott Valley are due primarily to an increase in drilled domestic wells from 108 to 913 between 1970 and 2002 (Bennett 2005). This growth in residential water use is likely to continue into the future.

As the value of farm lands increased throughout the Klamath River Basin, flood control measures were implemented. During the 1930s, the U.S. Army Corps of Engineers implemented flood control measures in the Scott River Valley by removing riparian vegetation and building dikes to constrain the stream channel. As a result of building these dykes (banking), the river became more channelized, water velocities increased, and the rate of bank erosion accelerated. To minimize this damage, the Siskiyou Soil Conservation Service planted willows along the stream-bank and recommended channel modifications take place which re-shaped the stream channel into a series of gentle curves.

Since the late 1980s, the Klamath Fisheries Restoration Act has fostered partnerships with the agricultural community in the Klamath Basin to improve aquatic habitat conditions and stream flows in a manner that benefits anadromous fish. Eighty-four (84) fisheries and habitat improvement projects at a cost of $3,169,232 were implemented by 2006. These projects include riparian habitat restoration, in-stream restoration, fish rearing, water conservation, water quality improvements, and upland restoration (USFWS 2006), providing a foundation for more complex and costly anadromous fisheries restoration projects that remain to be done. Future efforts will include improving fish passage at agricultural and other water diversions, repairing dredger-mined channels, stormproofing or decommissioning additional roads, and reducing forest fuels which threaten to create damaging wildfires.

### 5.4.7 Fire, floods and drought

Floods have been a major influence on the condition of streams and rivers in the Klamath River Basin. Large floods are documented for parts of the Klamath River in 1861, 1864, and 1875. Examination of streamflow data from the Klamath River near Seiad Valley report a December 23, 1964 flood that generated 165,000 cubic feet per section (cfs), and a January 1, 1997 flow of 117,000 cfs. Flow data on the Scott River show the same storms generated 54,600 and 34,300 cfs respectively (USGS 2010).

Within the action area extensive landsliding occurred during the floods of 1955, 1964, 1970 to 1974, and 1997 (USFS 2002). These floods occurred when relatively warm storm systems melted a preexisting snowpack (rain-on-snow event) (USFS 2002). An air photo flight showing the aftermath of the 1964 flood shows extensive disruption of riparian vegetation along virtually all stream courses in the action area (USFS 2002).

Few forested regions experience fires as frequently and with such high variability in severity as those in the Klamath Mountains (Taylor and Skinner 1998). The fire regime prior to European settlement (1850) within the Klamath area can be described as having frequent fires with return intervals of 1 to 25 years. Lightning and American Indian burning were the predominant causes of ignition (USFS 1996, 1999, 2000, 2002). The pre-European fire regime can be described as having mostly low- to moderate-intensity fires, with only small areas burning at high intensity. Fire return intervals were shorter on exposed sites and longer on sheltered sites. The steepness of the slopes and vegetation that had adapted to a history of frequent fires contributed to the varying intensities. Fire worked as both a thinning agent and an agent of decomposition. Although most vegetation (mixed conifers) promoted lower intensities when burned at frequent intervals, stand-replacing events occurred in some areas.

Fire frequency, intensity, and size occurring within the action area has changed since the intentional fire-suppression era (1950 to present) (Fry and Stephens 2006). Prior to the fire-suppression era, fires occurred frequently, spreading without human intervention over large expanses and affecting the habitat in a heterogeneous manner; the HCP area was completely burned on average during a period of 8 to 25 years (USFS 2002). Fires occurring in the fire-suppression era are less frequent and have greater intensity, resulting in a more homogeneous effect on the habitat by damaging and removing all vegetation as fires burn typically much hotter than historically (Fry and Stephens 2006). These intense fires can result in large swaths of riparian habitat being destroyed as hot fires can completely kill riparian forests, resulting in large areas prone to erosion and loss of shade-producing canopy along stream corridors. Aspect, stand diameter, elevation, and topography are all factors that influence fire intensity within the Klamath region (Taylor and Skinner 1998, Fry and Stephens 2006, Alexander et al. 2006).

### 5.4.8 Harvest

Coho salmon have been harvested in the past in both coho- and Chinook-directed ocean fisheries off the coasts of California and Oregon. More stringent management measures that began to be introduced in the late 1980s have reduced coho salmon harvest substantially. Initial restrictions in ocean harvest were due to changes in the allocation of Klamath River fall-run Chinook salmon (KRFC) between tribal and non-tribal fisheries. These restrictions focused on the Klamath Management Zone where the highest KRFC impacts were observed (Good et al. 2005). A prohibition on coho salmon retention was expanded to include all California waters in 1995 (Good et al. 2005). With the exception of some authorized harvest by the Yurok, Hoopa Valley and Karuk Tribes for subsistence, ceremonial and commercial purposes,[1] the retention of coho salmon is also prohibited in California river fisheries. Projected exploitation rates on Rogue/Klamath River hatchery coho salmon stocks are calculated during the preseason planning process using the coho salmon Fishery Regulation Assessment Model (Kope 2005). Season options are then crafted that satisfy a 13 percent maximum ocean exploitation rate. In recent years, these rates have been well below 13 percent with five of the last eight years at or below 6 percent and no year exceeding 9.6 percent. Post-season estimates are not performed due to a lack of information necessary to generate accurate expansions of in-river coded wire tag (CWT) recoveries (Kope 2005). Tribal and other harvest effects are expected to continue.

### 5.4.9 Hatcheries

Two fish hatcheries operate within the Klamath River basin, Trinity River Hatchery (TRH) near the town of Lewiston and Iron Gate Hatchery (IGH) on the mainstem Klamath River near Hornbrook, California. Both hatcheries mitigate for anadromous fish habitat lost as a result of the construction of dams on the mainstem Klamath and Trinity Rivers, and production focuses on Chinook and coho salmon, and steelhead. TRH releases roughly 4.3 million Chinook salmon, 0.5 million coho salmon and 0.8 million steelhead annually. IGH releases approximately 6.0 million Chinook salmon, 75,000 coho salmon and 200,000 steelhead annually, for a total of roughly 11,875,000 hatchery salmonids released into the Klamath Basin annually. IGH releases Chinook salmon from the middle of May to the end of June, a time when discharge from IGD is in steep decline and water temperatures are rapidly rising, which may create competition between hatchery and natural fish for food and limited resources, especially limited space and resources in thermal refugia.

Hatchery operations may have a suppressive effect on coho salmon through predation and competition, and it should not be assumed that hatchery operations are beneficial to salmonids or to coho salmon in particular (CETFKRB NRC 2004). When released into the freshwater, hatchery fish may compete with naturally produced fish for food and habitat (McMichael et al. 1997, Fleming et al. 2000, Kostow et al. 2003, Kostow and Zhou 2006). The exact effects on juvenile coho salmon from competition and displacement in the Klamath River from the annual release of 6,000,000 hatchery-reared Chinook salmon smolts from IGH are not known. However, Chinook salmon are released from IGH at virtually the same time that coho salmon peak emigration occurs in the Klamath River, near the middle of May. In a review of 270 references on ecological effects of hatchery salmonids on natural salmonids, Flagg et al. (2000)

[1] Good et al. (2005) reported that coho salmon harvest by the Yurok tribe, which were the only tribal harvest data available, ranged from 42 to 135 fish between 1997 and 2000 and increased to 895 fish in 2001. The majority of this catch (63-86 percent) was comprised of hatchery fish.

found that, except in situations of low wild fish density, increasing release numbers of hatchery fish can negatively impact naturally produced fish. It was also evident from the review that competition of hatchery fish with naturally produced fish almost always has the potential to displace wild fish from portions of their habitat (Flagg et al. 2000). The substantial increase in density of juvenile salmonids, combined with the reduction in instream habitat resulting from decreased flows in May resulting from hydrologic alteration of the Klamath River (see Dams and Diversions section above), could have negative impacts on coho salmon juveniles. During May, and into the summer, sometimes hundreds or even thousands of juvenile salmonids can be forced by water temperatures into small areas with cold water influence (Sutton et al. 2007). The CETFKRB NRC (2004) recommended altering the number of fish released at IGH and TRH in order to gain a better understanding of the extent to which hatchery fish impact natural production.

Another important factor that may adversely affect SONCC coho salmon diversity, spatial structure, and productivity is whether and to what degree smaller coho salmon populations from tributaries such as the Scott and Shasta Rivers, which are important components of the ESU viability, are affected by straying of hatchery fish. Pearse et al. (2007) found that hatchery steelhead adults sampled from IGH in 2001 clustered strongly [genetically] with smolts sampled by screw trap in the Shasta and Scott Rivers, suggesting that significant gene flow has occurred between IGH and these nearby tributaries, presumably due to 'straying' of returning hatchery adults. Outmigrating hatchery smolts are known to utilize the Shasta River, so it is likely that some may return to spawn there as well (Pearse et al. 2007). Although it is possible that the screw trap samples represent mixtures of smolts originating from multiple, distinct, upstream populations, the pairwise $F_{ST}$ (Fixation index, a measure of population differentiation values) between IGH and the screw trap samples were among the lowest significant values observed (0.004–0.009), supporting the hypothesis of high gene flow between the hatchery and these populations (Pearse et al. 2007). CDFG (2002) found that 29 percent of coho salmon carcasses recovered at the Shasta River fish counting facility (SRFCF) had left maxillary clips in 2001, indicating that they were progeny from IGH. The average percentage of hatchery coho salmon carcasses recovered at the SRFCF from 2001, 2003, and 2004 was 16 percent (Ackerman and Cramer 2006). These data indicate that substantial straying of IGH fish occurs into important tributaries of the Klamath River, like the Shasta River, which has the potential to reduce the reproductive success of the natural population (Mclean et al. 2003, Chilcote 2003, Araki et al. 2007) and negatively affect the diversity of the interior Klamath populations via outbreeding depression (Reisenbichler and Rubin 1999, HSRG 2004).

The effects due to hatcheries are expected to continue for the foreseeable future, potentially increasing over time due to climate change as more fish attempt to find potentially diminishing areas of cold water refugia (Mote et al. 2003, Battin et al. 2007); therefore, competition for limited thermal refuge areas are expected to increase. Bartholow (2005) found a warming trend of 0.5°C/decade in the Klamath River and a decrease in average length of river with temperatures below 15°C (8.2 km/decade), underscoring the importance of thermal refugia areas. However, hatchery releases are expected to remain constant during this period of shrinking freshwater habitat availability, which makes the detrimental impact from density-dependent mechanisms in the freshwater environment to naturally produced coho salmon populations increase through time under a climate warming scenario. In this way, hatcheries impact the critical habitat of coho salmon by limiting the amount of space available to rearing juveniles.

Behrenfeld et al. (2006) found that ocean productivity is closely coupled to climate variability. A transition to a warmer climate state and sea surface warming may be accompanied by reductions in ocean productivity which affect fisheries (Beamish and Mahnken 2001, Ware and Thomson 2005, Behrenfeld et al. 2006). The link between total mortality and climate could be operating via the availability of nutrients regulating the food supply and hence competition for food (i.e., bottom–up regulation) in the ocean (Beamish and Mahnken 2001, Ware and Thomson 2005). Hatchery releases may exacerbate the effect of reductions in ocean productivity on naturally produced salmonids through density-dependent mechanisms, which have their strongest effect during the first year of salmonid life in the ocean (Beamish and Mahnken 2001), because hatchery releases are rarely reduced during years of poor ocean productivity (Beamish et al. 1997, Levin et al. 2001, Sweeting et al. 2003). These competitive effects in the ocean may negatively affect the population abundance and productivity of the interior Klamath populations.

### 5.4.10 Fish Disease

Pathogens associated with diseased fish in the Klamath River include bacteria (*Flavobacterium columnare* and motile aeromonid bacteria), a digenetic trematode (presumptive *Nanophyetus salmincola*), myxozoan parasites (*Parvicapsula minibicornis* and *Ceratomyxa shasta*) and external parasites (Walker and Foott 1993, Williamson and Foott 1998). Ceratomyxosis (due to *C. shasta*) has been identified as the most significant disease for juvenile salmon in the Klamath Basin (Foott et al. 1999 Foott et al. 2007). Significant kidney damage (glomerulonephritis) has been associated with *P. minibicornis* infection; however, the prognosis of such infections is not fully understood. Individuals with dual infections of *C. shasta* and *P. minibicornis* would likely have low survival rates (Nichols and Foott 2005).

*C. shasta* and *P. minibicornis* are myxosporean parasites found in a number of Pacific Northwest watersheds (Hoffmaster et al. 1988; Bartholomew et al. 1989; Jones et al. 2004; Bartholomew et al. 2006). Both parasite life cycles include the polychaete, *Manayunkia speciosa*, as an alternate host (Hoffmaster et al. 1988, Jones et al. 2004, Bartholomew et al. 2006). The actinospore, a stage that is infectious to salmon, is released from infected polychaetes into the water column, and infections by *C. shasta* can occur from spring through fall at water temperatures > 7°C (Ching and Munday 1984). Myxospores develop within infected salmonids (particularly migratory adults infected during declining water temperature periods), and it is this stage that, once shed from fish, can infect polychaetes to complete the life cycle (Bartholomew et al. 1997). Studies conducted in 2004 and 2005 suggest that *P. minibicornis* has seasonality similar to that of *C. shasta*, while its actinospore concentration and infectivity appears greater than *C. shasta* (Foott et al. 2007; Nichols and Foott 2005; Bartholomew et al. 2007).

Researchers believe modifications to the river's historical hydrologic regime have likely created instream conditions that favor disease proliferation and fish infection (Stocking and Bartholomew 2007). Less frequent fall pulse-flows may affect disease transmission from adult salmon carcasses to the intermediate polychaete host. Under an unaltered hydrologic regime, fall and winter freshets help distribute salmon carcasses downstream into lower sections of the watershed, effectively dispersing nutrients, as well as infective spores that enter the aquatic environment as the carcass decomposes. The current flow regime does not effectively redistribute carcasses within the IGD to Shasta River reach, resulting in high densities of decomposing fish downstream of popular spawning areas, specifically the areas directly below IGH and the confluence of Bogus Creek and the Klamath River mainstem. Compounding the issue is the large number of returning adult salmon that congregate and spawn in areas adjacent to the hatchery, thus increasing carcass concentrations in the IGH to Shasta River reach above natural levels. The high carcass densities have helped create areas where high spore loads from decomposing carcasses combine with an unchecked polychaete population. Researchers theorize that these areas represent a zone of disease nidus where the rate and efficiency at which disease pathogens are transmitted from polychaete host to juvenile salmonids dramatically increase (Stocking and Bartholomew 2007).

High winter and spring flows of 2006 were considered to provide a "natural experimental flow." IGD flows exceeded 10,000 cfs in April of 2006 and sustained high flows lasted through the spring. This period of high flows was anticipated to have an effect on disease infection rates through the disruption or destruction of polychaetes, reduced actinospore concentrations, or juvenile salmonid exposure timing (Stocking and Bartholomew 2007). The results of the USFWS spring 2006 monitoring study indicated the prevalence of both *C. shasta* and *P. minibicornis* during May and June was lower in 2006 compared to previous studies in 2004 and 2005. The higher flows appeared to delay the peak of infection for both parasites, but peak prevalence of infection was still similar in magnitude to previous monitoring studies (Foott et al. 2007). The delayed infection rates in 2006 may have resulted from one or more of the following: (1) A reduction in the polychaete host involved in the life cycle of these parasites due to scouring associated with high flows, (2) A dilution effect on the actinospore (infectious to fish) stage of the parasites; (3) A reduced transmission/infection efficiency of the parasites due to environmental conditions (temperature, turbidity, velocity). Results from the 2007 monitoring study indicate 37 percent of coho salmon juveniles tested positive for *C. shasta* and 66 percent of coho salmon juveniles tested positive for *P. minibicornis.* Disease prevalence rates were highest in the Upper Klamath River reach in mid-May when flows at IGD ranged from 1400 to 1700 cfs.

High water temperatures can stress adult salmon and slow upstream migration rates, facilitating the transmission of bacterial pathogens (e.g., *Ichthyopthirius multifilis* and *Flavobacterium columnares*) between healthy and sick fish as they crowd into the few cold water refugial areas of the Klamath River (USFWS 2003). High water temperature was one of several factors that likely contributed to a massive die-off of Klamath River salmon in 2002 – other factors include run timing, run size, habitat availability, and meteorological conditions (USFWS 2003). Of the over 34,000 fish estimated to have died during the 2002 event, approximately 344 were coho salmon (CDFG 2004). The effects to coho salmon due to disease are expected to continue throughout the term of the permit and into the foreseeable future unless dam removal occurs restoring a natural hydrograph to the system which would be likely to reduce disease-forming conditions in the Klamath River mainstem. Disease effects are likely to negatively impact all of the VSP parameters of the Interior-Klamath population units because both adults and juveniles can be adversely affected. In terms of critical habitat, disease impacts adult and juvenile migration corridors, and juvenile summer rearing areas.

### 5.4.11 Climate Change

Climate change is a global environmental phenomenon that is likely to occur irrespective of the proposed action and is likely to have a negative impact on salmonids throughout the Pacific Northwest due to large reductions in available freshwater habitat (Battin et al. 2007). The hydrologic characteristics of the Klamath River mainstem and its major tributaries are dominated by seasonal melt of snowpack (CETFKRB NRC (2004). Van Kirk and Naman (2008) found statistically significant declines in April 1 Snow Water Equivalent (SWE) since the 1950's at several snow measurement stations throughout the Klamath Basin, particularly those at lower elevations (<6000 ft.) Mayer and Naman (2011) found declines in winter precipitation in the upper-Klamath Basin.

How the warming trend and low elevation decrease in SWE will affect coho salmon in the Klamath Basin is unclear. However, 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. 2005), as well as lower flows in the summer (Hamlet and Lettenmaier 1999, Stewart et al. 2005), and warmer water temperatures in the Klamath River (Bartholow 2005). Low flows in the summer are one factor that has been cited as limiting coho salmon survival and distribution in the Klamath River, and tributaries such as the Scott River (CDFG 2002, CETFKRB NRC 2004). Although climate models diverge with respect to future trends in precipitation over this region, there is widespread agreement that the trend toward lower SWE and earlier snowmelt will continue (Leung and Wigmosta 1999, McCabe and Wolock 1999, Miller et al. 2003, Snyder and Sloane 2005, Barnett et al. 2005, Zhu et al. 2005, Vicuna et al. 2007). Thus, availability of water resources due to future climate scenarios is expected to be most limited during the late summer (Gleick and Chalecki 1999, Miles et al. 2000).

The likely effects of a changing climate (decreased summer flows and increased temperatures) coupled with the uncertainties of other responses (e.g., changes in the sedimentation regime) highlight the need to preserve and enhance the diversity found with each species. Salmonids within the action area show a range of life history diversity, such as age at outmigration (e.g., Shasta River juvenile coho salmon) or timing of adult returns (e.g., summer steelhead). Although our previous discussions indicated that much of this diversity has either already been lost or is at risk of loss, maintaining and enhancing the existing diversity is likely prudent in the face of the uncertainties surrounding climate change. More specific to the action area is the need to preserve and enhance existing cold water refugia and areas of relatively unimpaired streamflows. Such projections on future climate trends in the action area are adopted in reference to the assessment of the future impacts of climate change for the purposes of the analysis in this Opinion.

### 5.4.12 Summary of Factors Affecting Covered Species and their Habitat and Key Stressors in the Action Area

Numerous stressors and activities are responsible for the declines in viability of salmonid populations in the action area. Some activities such as mining and timber harvest are much less pervasive and more regulated than earlier periods which resulted in extensive habitat modifications. However, the legacy effects from these earlier activities are still observable on the landscape.

Key points from our assessment of the Environmental Baseline that are relevant to the proposed action are:

- Tributary streams to the mainstem Klamath and Scott Rivers provide habitat functions not only for fish that reproduce within these reaches, but also function as essential refuge habitats as mainstem river conditions fluctuate seasonally.
- Maintenance of cold water in the tributary reaches is vital to the continuing survival of covered species in the action area, particularly SONCC coho salmon.
- Summer streamflows in action area tributaries may serve as important refuge habitat for fish from the mainstem reaches.
- Sediment sources, particularly fine sediment from chronic erosion processes, may be impairing reproductive success in action area tributary streams.
- Low LWD supply is likely currently limiting juvenile salmonid production.
- Although improvements to habitat access have been made over the last several decades, significant habitat areas remain inaccessible during critical life history stages due to anthropogenic causes.
- With the exception of the mainstem Klamath River, nutrient levels in the tributary streams do not appear to be adversely affecting salmonid survival in excess of what would be expected in an unmanaged setting.

All of the physical and biological processes that influence salmonid populations in the action area have been altered outside of the range of conditions the species have evolved with over millions of years. No single stressor is completely responsible for the depressed status of the species noted earlier in this section. The mainstem Klamath River, which hosts a number of populations of salmon and steelhead, suffers significantly from poor water quality conditions. As water quality and flow conditions deteriorate in the mainstem Klamath River during the summer as water is captured and stored behind dams, smaller mainstem tributaries in the action area can become critical refuges for fish from multiple populations. Additionally, many of these important tributaries are relatively unaffected by stream diversions. Therefore, preserving and improving the existing streamflow and temperature conditions in these tributaries as well as improving long-term riparian habitat such as providing sources of adequate LWD and maintaining streambank stability during peak flows, is essential to maintaining and improving currently non-listed salmonid populations and eventually recovering SONCC coho populations in the action area.

# 6 EFFECTS OF THE ACTION

Pursuant to Section 7(a)(2) of the ESA, Federal agencies are directed to insure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The purpose of the analysis in this Opinion is to determine if the direct and indirect effects of the proposed action, and any interrelated or interdependent actions, when added to the environmental baseline and any cumulative effects of future non-federal actions are likely to jeopardize the continued existence of the anadromous salmonids proposed for incidental take coverage under the HCP or destroy or adversely modify designated critical habitat. Specifically, NMFS will analyze the direct and indirect effects of the proposed action on SONCC coho salmon, Upper Klamath and Trinity

Rivers Chinook salmon, KMP steelhead and designated SONCC coho salmon critical habitat. The status of each species and the condition of critical habitat was previously described in the *Status of the Species* and *Environmental Baseline* sections. The effects analyses determine the anticipated effects of the proposed action across two watersheds comprising the action area analyzed for effects: the Scott River and the Upper Klamath River watershed as defined in Williams et al. (2006). Therefore, the analyses will consider effects over the life of the 50-year ITP and effects that would continue beyond the life of the ITP. For example, harvesting in the last decade of the ITP has the potential to influence landslide rates beyond the 50-year permit period. Thus, the effects analysis is concerned with conditions existing in the decades following the 50-year permit period when longer-term effects have been realized.

The decline and extinction of genetically isolated (e.g., Sacramento River coho salmon) Pacific salmon populations has been linked to habitat loss and degradation in their spawning and rearing streams (Nehlsen et al. 1991). As a result, and because many of the proposed HCP activities have the potential to adversely affect aquatic habitat, this assessment of the effects of the action associated with the proposed ITP for FGS on three salmonid ESUs, and designated critical habitat is primarily habitat-based.

The relationship between changes in habitat quantity, quality, and connectivity and the status and trends of fish and wildlife populations has been the subject of extensive scientific research and publication, and the assumptions underlying our assessment are consistent with this extensive scientific base of knowledge. For more expansive discussion of and data supporting the relationship between changes in habitat variables and the status and trends of fish and wildlife populations, readers should refer to the work of Fiedler and Jain (1992), Gentry (1986), Gilpin and Soulé (1986), Nicholson (1954), Odum (1971, 1989), and Soulé (1986). For detailed discussions of the relationship between habitat variables and the status and trends of salmon populations, readers should refer to the work of FEMAT (1993), Gregory and Bisson (1997), Hicks et al. (1991), Murphy (1995), National Research Council (1996), Nehlsen et al. (1991), Spence et al. (1996), Thomas et al. (1993), The Wilderness Society (1993), and any of the numerous references contained in this rich body of literature.

Gregory and Bisson (1997) stated that habitat degradation has been associated with greater than 90 percent of documented extinctions or declines of Pacific salmon stocks. This conclusion is also supported by Lichatowich (1989) who identified habitat loss as a significant contributor to stock declines of coho salmon in Oregon’s coastal streams. Beechie et al. (1994) estimated a 24 percent and 34 percent loss of coho salmon smolt production capacity of summer and winter rearing habitats, respectively, since European settlement in a Washington stream. Beechie et al. (1994) identified three principal causes for these habitat losses, in order of severity of habitat impacts, as hydromodification (e.g., dams and diversions), migration-blocking culverts, and forest practices. Several authors have found positive relationships between habitat complexity, LWD in streams, and salmonid populations (Tschaplinsky and Hartman 1983, Reeves et al. 1993, McMahon and Holtby 1992). Nickelson and Lawson (1997), in modeling extinction risk of coho salmon along the Oregon coast, found that probability of extinction was inversely related to habitat quality for starting populations of 50 and 100 individuals. Furthermore, Nickelson and Lawson (1997) found that there would be a substantial increase in risk of extinction for Oregon coast coho salmon in basins with poor habitat quality if habitat quality declines by 30-60 percent over the next century.  The regulations that listed the different Pacific salmon ESUs as threatened and endangered species reflected this body of evidence by stressing the role of present and threatened destruction, modification, and curtailment of aquatic habitat in the decline of Pacific salmon.

These references establish that the value of habitat for any species is largely determined by the quantity and quality of the resources available in the species' habitat and is usually represented by the number of individuals the habitat can support at any point in time (this is commonly referred to as the habitat's "carrying capacity").  If the population size or vital rates of a listed species are limited by one or more of the physical, chemical, or biotic resources available in the species' "habitat" then reducing the quantity or quality of those limiting resources would also be expected to reduce the species' reproduction, numbers, or distribution.  The physical, chemical and biotic resources that constitute a species' habitat fluctuate with time and space, which is why species use different habitats or the same habitat for different reasons at different stages of their development and at different times of an annual cycle.

Based on this body of scientific evidence available, populations of threatened and endangered Pacific salmon are limited by the existing condition of aquatic habitat and that their populations are depleted, at least partially, as a response to those limited habitat conditions.  The *Environmental Baseline* section established that habitat conditions in the action area have been degraded by past and ongoing activities.  Degradation of aquatic habitat in the action area currently limits populations of listed and unlisted salmon in the action area; and in fact, in many of the streams in the action area, salmon populations have become locally extinct in response to degraded habitat conditions.

### 6.1 Physical and Biological Processes Influencing Salmonids and Their Habitat

The discussion that follows contains general information about the action area, and does not contain a reach-by-reach analysis.  Where information is available to point out areas of special concern, we highlight these.  Table 12 describes the distribution of covered species in proximity to FGS Covered Lands for Class A and B watersheds and highlights the percentage of the watershed owned by FGS where covered activities may affect individuals of covered species.

Adding to the complexities of constructing the environmental baseline is the generally dispersed nature of the FGS ownership.  Although we have defined the action area to include two principal watersheds that correspond to coho salmon historic population structure (Upper Klamath and Scott Rivers), we recognize that many drainages within these historic population units do not contain or have very limited FGS lands, and therefore may not be subject to effects of FGS' activities.  Where specific instances arise regarding the relation between the location of FGS lands and effects on one or more salmonid species, these are discussed on a case-by-case basis, as needed.

**Table 12. Status of Covered Species Distribution in Action Area Analyzed for Effects Including Proximity to HCP Plan Area Lands and Watershed Ownership**

| **Historic or Current Coho Population** Subwatershed | FGS Implementation Class | Current Coho Salmon Presence | FGS Ownership (acres) | *percent* of watershed owned by FGS | *percent* of watershed in Federal management | Miles of coho streams on or near FGS lands | Miles of Chinook streams on or near FGS lands | Miles of steelhead streams on or near FGS lands |
|---|---|---|---|---|---|---|---|---|
| **Upper Klamath River** | | | | | | | | |
| Beaver | A | Y | 16,936 | 24 | 64 | 2.2 | 3.4 | 5.4 |
| Cottonwood | A | Y | 16,537 | 26 | 26 | -- | -- | 5.7 |
| Doggett | A | Y | 3,992 | 52 | 38 | -- | -- | 0.2 |
| Dona | A | Y | 2,518 | 30 | 39 | -- | -- | -- |
| Dutch Creek | A | Y | 2,987 | 46 | 24 | -- | -- | -- |
| Empire Creek | A | Y | 2,667 | 44 | 48 | 1.5 | -- | 1.8 |
| Horse | A | Y | 9,695 | 25 | 64 | -- | -- | -- |
| Lumgrey Creek | A | Y | 2,519 | 46 | 42 | -- | -- | -- |
| Middle Klamath | A | Y | 1,434 | 1 | 44 | -- | -- | -- |
| Seiad | A | Y | 1,445 | 4 | 72 | -- | -- | -- |
| Willow Creek | B | N | 979 | 4 | 5 | -- | -- | -- |
| Bogus Creek | B | Y (far downstream of FGS lands) | 1,982 | 6 | 27 | -- | -- | -- |
| **Scott River** | | | | | | | | |
| Big Ferry | A | Y | 1,275 | 20 | 51 | -- | -- | -- |
| Canyon | A | Y | 1,965 | 15 | 55 | -- | -- | -- |
| Indian | A | Y | 3,952 | 29 | 34 | -- | -- | -- |
| Meamber | A | Y | 5,059 | 61 | 0 | -- | -- | -- |
| Mill | A | Y | 1,437 | 10 | 47 | -- | -- | -- |
| Moffett | A | Y (at lowest reach) | 3,503 | 21 | 17 | -- | -- | 1.3 |
| Pat Ford | A | Y | 2,172 | 28 | 49 | -- | -- | -- |
| Patterson | A | Y | 2,103 | 52 | 27 | -- | -- | -- |
| Rattlesnake | A | Y | 1,068 | 10 | 22 | -- | -- | -- |

| **Historic or Current Coho Population** Subwatershed | FGS Implementation Class | Current Coho Salmon Presence | FGS Ownership (acres) | *percent* of watershed owned by FGS | *percent* of watershed in Federal management | Miles of coho streams on or near FGS lands | Miles of Chinook streams on or near FGS lands | Miles of steelhead streams on or near FGS lands |
|---|---|---|---|---|---|---|---|---|
| Duzel | B | N | 11 | <1 | 1 | -- | -- | -- |
| EF Scott | B | Y (goes dry in summer) | 186 | <1 | 32 | -- | -- | -- |
| McConaughy | B | N | 124 | 1 | 8 | -- | -- | -- |
| Shasta Valley | B | Y | 545 | <1 | 15 | -- | -- | -- |
| Moffett | B | N | 14,941 | -- | | | | |

### 6.1.1 Effects on LWD Recruitment Processes

Woody debris in action area streams has declined substantially due to a combination of agricultural development, timber harvest, high intensity fires, mining, and residential development. Collectively, these activities have reduced the quantity and quality of stream habitat throughout the action area. Federally managed lands and private timberland in the action area are the areas where LWD processes are most easily restored.

In-stream woody debris provides a fundamental habitat component for salmonids in forested settings. The role of woody debris in forming habitat for salmonids is well documented (e.g., Spence et al. 1996). Large pieces of wood delivered from hillslope sources including blowdown of streamside stands and delivery from landslides provide many habitat functions. These include:

- *Storage and routing of sediment.* Individual pieces and accumulations of wood act as check dams that moderate the delivery of sediment to downstream reaches. This helps to preserve downstream habitat features such as pools which might be wiped out with large, relatively instantaneous delivery of sediment. In steeper reaches, the storage of sediment behind debris jams may provide spawning habitat.
- *Pool scour.* Woody debris provides stable roughness elements in a channel where pools form, resulting in juvenile rearing and adult holding habitat.
- *Cover.* Pieces and jams provide cover from predation and high water velocities.

As the supply of woody debris decreases or is lacking altogether, the effects on salmonids are numerous. The decrease in pool quantity and quality described above will limit the amount of rearing habitat and cover available for juvenile salmonids, particularly juvenile coho salmon which depend on pools as the principal habitat type for rearing (Meehan and Bjornn 1991, Tschaplinski and Hartman 1983). As a result, competitive pressures increase resulting in reduced growth rates and mortality. Mortality rates and predation increase due to the lack of cover provided by the woody debris (Everest et al. 1985 *op cit.* Spence et al. 1996).

*Effects of HCP Implementation on LWD Recruitment*

The HCP describes several activities that influence the supply of woody debris to streams. These activities include: (1) riparian management including delineation of WLPZs and harvest activities within WLPZs, (2) harvest on existing unstable ground and potentially unstable areas (i.e., inner gorges and headwall swales), and (3) road construction and maintenance. Specific conservation measures are included in the aquatic conservation program to address LWD recruitment processes. For each activity, the effectiveness of the proposed measures is assessed.

*Riparian Management*

One of the objectives of FGS's riparian management strategy is to ensure that an adequate number of appropriately sized trees are maintained in the stand at all times to maintain and enhance the potential contribution of functionally-sized LWD through time. The abundance and distribution of LWD in a stream is a function of several variables, including tree growth, tree mortality, bank erosion, mass-wasting, stream transport and decay. Since all of these factors are likely to vary from one region to another and some of the variables are difficult to estimate over large areas (e.g., relative contribution of LWD through tree mortality, windthrow, bank erosion and mass wasting), it is impossible to narrowly define in-stream targets for LWD pieces or volumes, and impractical to manage riparian forests to meet such targets in the face of environmental variability. Instead, FGS has chosen to manage their riparian forests via conservative WLPZ protections, high riparian canopy requirements, and protection of streamside unstable areas to provide the potential for in-stream LWD to be generated over the life of the HCP. LWD "potential" refers to the number of trees in the adjacent riparian stand that have the potential to contribute wood to the stream of the appropriate size to be functional for salmonid use should they fall ("recruit") to the adjacent stream. These pieces may be recruited through a variety of methods as the stand ages. Generally, the larger a tree grows the greater potential it has remaining stable in the stream if it recruits, allowing for scour to occur around the fallen tree creating covered pools for salmonids. Fallen large trees can also span a stream creating a log weir which can provide for a deep pool downstream of the tree(s) suitable as holding and rearing habitat for salmonids as they migrate upstream. Fallen large trees can also block access to upstream habitat if it creates a span higher than the jumping abilities of the migrating adult salmonids. These log jam migration barriers can last several years until natural scour processes erode around or under the jam to open upstream access again, absent human intervention (e.g. cutting a notch in the log jam). Bank erosion/undercutting, tree mortality, windthrow, and landslides (within the adjacent stand or that pass through the stand) can all result in LWD inputs to the stream from the adjacent stand.

The width of the WLPZ is a critical factor in determining how much woody debris is available for recruitment. In general, the wider the WLPZ, the more trees may be available over the long-term to recruit. Many studies and modeling efforts have examined the role of buffer widths in providing woody debris to streams (Murphy and Koski 1989; McDade et al. 1990; Van Sickle and Gregory 1990; Reid and Hilton 1998). In general, these studies indicate that riparian buffer widths equal to one-site potential tree height are adequate to provide for nearly unimpaired wood recruitment from streamside stands. In developing a wood budget for tributaries of the Trinity River, probably the closest geographically to the HCP area, Benda et al. (2003) found that in-stream LWD in this area is derived from a number of sources including bank erosion (42 percent), mortality (39 percent), landslides (17 percent), and debris flows (1 percent). Where a source could be determined, 80 percent of the wood entered the channel from within 19 m (62 ft.) of the stream edge (Benda et al. 2003).

The simplest means to assess the effectiveness of streamside buffer widths is to assume that wood recruitment is derived only from tree mortality and windthrow. Using this approach, the potential future recruitment of LWD can be crudely estimated based on a source-distance curve for coarse woody debris. Recruitment may also occur from upslope areas and this process is discussed later in this section.

Although not modeled beyond 50 years, NMFS assumes that most trees in the HCP Class I WLPZ areas will continue to grow beyond the expiration of the permit as it is unlikely there will be a reversal in riparian protection strategies should FGS lands revert to management under state laws.

*Class I Watercourses.* Table 13 provides the riparian management strategy proposed in the HCP. The table also shows the protection measures provided by the HCP beyond those required by the State of California (essentially the No Action Alternative or a part of the Environmental Baseline without the Proposed Action). Without an HCP, we assume that FGS would manage their timberlands consistent with the CFPRs unless federal intervention occurred.

**Table 13. Riparian management strategy proposed in FGS HCP**

| HCP | Protection Provided by HCP not in 2011 CFPR's |
|---|---|
| **Class A= coho standards** | |
| Class I Watercourse and Lake Protection Zone (WLPZ)<br>- 150' WLPZ always<br>- 0-75' 85% overstory canopy<br>- 75-150' 65% canopy<br>- 10 largest trees/330' of stream channel or 1 tree every 33'<br>- Does not have a "no- cut" Core Zone<br>- Requirement to leave trees providing shade to pools | -Always 150' WLPZ<br>- Higher canopy requirements out to 150' regardless of silviculture (shading and long-term recruitment potential)<br>-Does not have 0-30' no cut, but 13 largest trees per 330' must be left w/in 50' of watercourse.<br>- Requires pool shade trees to be left, CFPR's do not |
| Class I Inner Gorges<br>- For slopes >55% at the Class I boundary<br>- No clearcuts<br>- Retain 60% overstory canopy<br>- Extend to 330' or break-in-slope<br>- For slopes >65% requires PG review as add-on | -Prevents clearcutting even if a Professional Geologist (PG) said it was possible (extra measure of protection)<br>- Must always retain at least 60% canopy providing extra measure of protection. |
| Class II's<br>- 0-50' 85% overstory canopy<br>- 50-100' 65% overstory canopy<br>- 25% conifer overstory for both<br>- No requirement to retain large trees<br>- No option for Class II-Small (Class II-S), | - Class II- Large (Class II-L) may be better than standard HCP prescription (retain large trees, increase Quadratic Mean Diameter (QMD), 30' no cut)<br>- Class II-L can have limited application however, |

| | |
|---|---|
| HCP prescription applied throughout | compared to a standard property wide prescription |
| Class II Inner Gorge<br>- minimum 60% canopy to 200' or break-in-slope<br>- no clearcutting<br>- review by PG | -Additional protection for Class II Inner gorges leaving wood on areas prone to failure, prevents clearcuts on these features and requires PG evaluation |
| Class III<br>- 25-50' Equipment Limitation Zone (ELZ_ based on slope<br>- 50% understory retention in ELZ<br>- No burning in ELZ<br>- Retain 15 square feet basal area hardwood (target large hardwoods)<br>- No tractor yarding in ELZ | -Requires leaving understory for hillslope stability, reduction in potential surface erosion, no burning to maintain vegetation in ELZ, keep valuable hardwoods for slope stability, and greater limitations on tractor ops |
| Class III Inner gorge<br>- No clearcutting on feature<br>- Requires PG review<br>- Maintain 60% canopy on feature | -Provides additional protection by requiring geologic review and leaving trees on the feature to maintain greater stability. |
| Headwall swales<br>- Can only selection or thin harvest<br>- Maintain 60% canopy on feature<br>- Requires PG review if constructing or reconstructing road | -Provides additional review and protection measures for unstable features to maintain greater stability |

| **Class B** | See above |
| --- | --- |
| - Class I WLPZ same as Class A<br>- Class I inner gorge protection same as Class A | |

In the HCP for Class I watercourses in Class A and Class B designated lands (within drainages with anadromous salmonids), the minimum width of WLPZs on Class I (fish bearing) watercourses is 150 feet with 85 percent overstory canopy retention in the inner zone (0 to 75 feet) and 65 percent overstory retention in the remaining outer zone (see Appendix A for more detail on WLPZ protection measures). Because the high canopy cover and tree retention standards within the 75-foot inner zone severely limit harvest within the zone, it is likely that only a small number of trees, if any, would be harvested within Class I WLPZs (primarily from the outer zone). Occasionally, as adjacent stands are harvested, WLPZs will be lightly harvested to remove diseased trees or enhance riparian functions by encouraging growth on fewer trees. It is anticipated that harvest would result in the removal of 1 to 10 trees per acre within the WLPZ on a 10 to 15-year cycle. Most of the WLPZs are likely to remain unharvested for many years as they grow to reach the retention requirements.

Using a LWD model to predict the amount (volume) of LWD potentially recruited from the adjacent stand within 150 feet of the stream, the 75-foot wide inner zone, within which little harvest would occur, would provide approximately 95 percent of the site-potential LWD recruitment (Figure 8). The remainder of the WLPZ (outer zone) also has the potential to contribute to LWD. These results indicate that the proposed riparian management measures will maintain a high level of LWD recruitment potential over the permit term and will provide for an increase in this potential through time relative to current conditions.

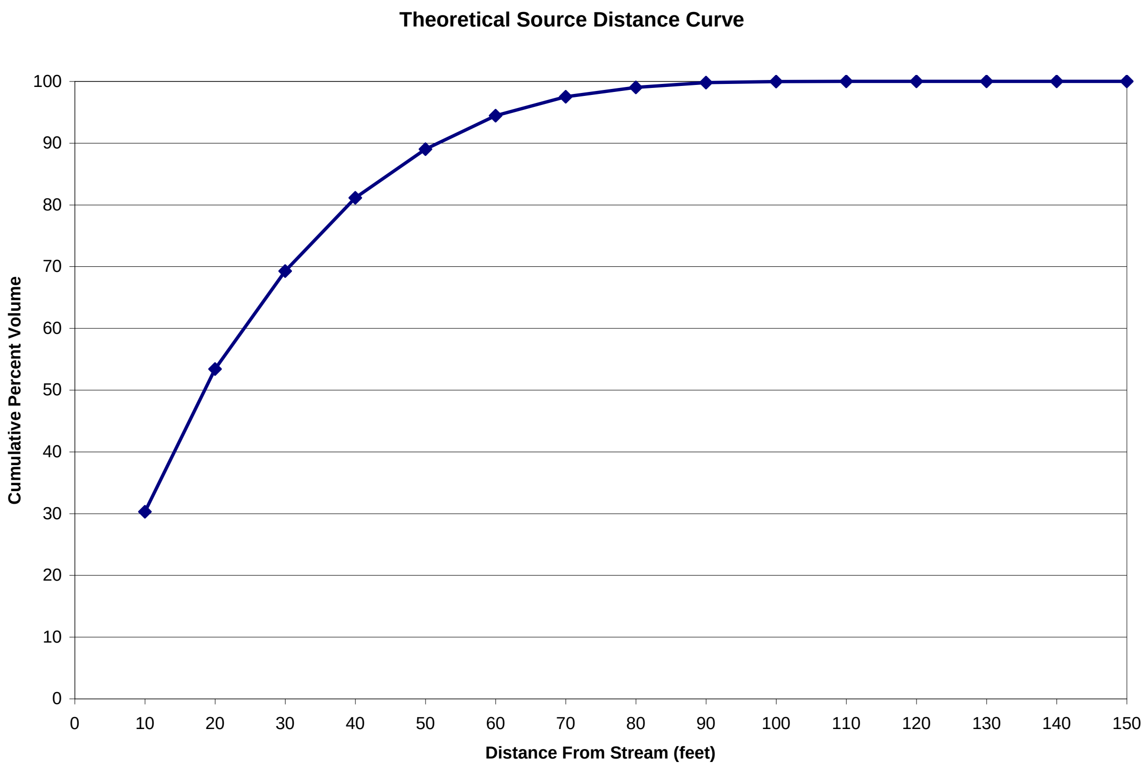


**Figure 8. Relationship between distance from stream bank and potential LWD recruitment (volume) from an older riparian stand (150-year stimulation) as predicted by LWD recruitment model using random tree positions (FGS 2009).**

While the canopy retention standards are anticipated to retain a high level of LWD recruitment potential from the riparian stands, probably the most important measures relative to the potential recruitment of LWD are the tree retention and salvage standards. In Class A and B designated lands, at least 10 of the largest conifers within 50 feet of the stream (approximately 5 trees on each side) will be retained for each 330 feet of stream within the WLPZ. Retained trees will include trees that are most conducive to LWD recruitment. In Class A designated lands with coho salmon, FGS will retain the 10 largest conifers per 330 feet of stream (on each side of the stream) within 100 feet of the stream and trees that contribute to direct shading of pools. This will ensure that the trees with the highest likelihood of recruiting LWD to the watershed and/or maintaining and enhancing pool forming processes will be protected.

Where clearcuts occur up to the edge of a riparian buffer (WLPZ), increased fall rates may exist for several years following harvest as the edge of the WLPZ becomes more subject to windfall conditions without an adjoining forested buffer (Reid and Hilton 1998). The increased fall rate in stands adjacent to recent clearcuts may deliver woody debris at higher rates than would be expected under unharvested conditions. However, given that some trees in the WLPZ stands are currently smaller than their site potential, some of the wood may be of limited function in the channel. Further, premature recruitment of this smaller material would reduce the quantity of wood available in the future, when the trees would have been larger and more functional.

The effects on removal of wood adjacent to fish-bearing streams is expected to be limited to a total of 14.4 total stream miles in the entire HCP area that could be harvested under the HCP, with no more than 3.7 of these miles supporting coho and Chinook salmon. Discussion of the implications of the modified recruitment regimes from WLPZs can be found in the summary of overall effects of wood recruitment on stream habitat and salmonids at the end of this section as well as in the *Integration and Synthesis* section where sediment delivery can also be factored into the analysis.

*Class II Watercourses*. Class II watercourses in HCP Class A designated lands will have a 100' WLPZ width. Canopy cover retention along Class II watercourses would average 85 percent within 50 feet of the stream and 65 percent outside of this inner zone (see Appendix A for more detail). In both zones, post-harvest canopy percentages must include a minimum of 25 percent conifer overstory. As for Class I WLPZs, the high retention standards in the inner zone of Class II WLPZs are anticipated to greatly limit harvest, restricting most harvest to light selection of available trees. In addition, the measures in the HCP restrict salvage operations in Class II streams in drainages with anadromous salmonids (Class A and B designated lands). Modeling results suggest that the proposed Class II WLPZ widths will provide approximately 90 percent of potential LWD recruitment from the adjacent stand (FGS 2009). Retaining large dead, dying, or diseased trees will further contribute to the high level of LWD recruitment potential from stands adjacent to these streams.

At these widths, the riparian vegetation in Class-II watercourses would provide a stable long-term supply of LWD for pool formation and improve conditions for the transport and storage of sediment in anadromous streams. Where abundant woody debris is present, sediment is stored behind wood. Wood serves to moderate sediment-related impacts to downstream fish-bearing habitats. Given the smaller size of Class II streams, individual pieces do not have to be as large in order to remain stable. However, the sediment storage capacity increases as piece size increases (O'Connor 1994). Wood in these channels may also represent an important source for downstream reaches. Where debris flows occur, the rapid export of wood from these lower order stream channels may provide important habitat elements in fish-bearing reaches (May 2002, Benda et al. 2003). Across the HCP area the primary impact on the 14.4 miles of potential salmonid habitat in regards to management of WLPZ's and woody debris concerns sediment and debris delivery to downstream reaches. These potential impacts will be considered in the *Integration and Synthesis* section at the end of this effects analysis where changes in sediment delivery can be integrated into the analysis. Effects of the WLPZ widths on stream temperatures are discussed in the appropriate section on stream temperatures.

*Class III Watercourses.* Riparian protection along Class III watercourses in Class A watersheds consists of a 25 or 50 foot wide equipment limitation zone (ELZ) depending on slope. Table 14 gives a summary of the protection measures proposed in the HCP. Class III WLPZ protection differs between Class A and Class B designated lands. The ELZ will be established in which ground-based yarding will be limited to end-lining with no tractor operations allowed. At least 50 percent of the understory vegetation present before timber operations shall be left living as well as leaving channel trees to maintain soil stability within the Class III channel. In Class B watersheds standard CFPR's for Class III channels will be applied which establishes the same ELZ but would allow tractor operations on slopes less than 50 percent gradient.

In terms of wood supply to the stream network, it is anticipated that Class III watercourses will provide some wood by the retention of snags and small diameter trees, and regrowth of stands between harvests. The retention of trees within the channel and overlapping the edge of the channel zone should contribute to in-channel LWD over the life of the permit. In terms of effects on sediment in the system, the retention of single trees along the banks of the Class III channels with even-aged management allowed in and adjacent to the ELZ may lead to increased susceptibility of blowdown. Blowdown of large trees can increase sediment to the watercourse as the root base of the tree often contains soil which can erode during rain events. The overall cumulative effect of class III considerations is discussed in the *Integration and Synthesis* section where the roles of sediment, wood and water are collectively analyzed.

*Unstable area management*

Geologic processes can be important in providing LWD to streams, and in some situations, they may be the primary mechanism by which LWD reaches streams. In particular, shallow rapid landslides have the potential to deliver large amounts of LWD when they form on connected headwall swales or within inner gorges. In addition, debris torrents from small headwater Class II and III watercourses can be an important source of LWD when they empty directly into Class I or large Class II watercourses.

The aquatic conservation program contains measures designed to reduce the incidence of management-related mass wasting in an effort to control excessive sediment delivery to fish-bearing watercourses. Landforms are identified which have a high likelihood of failure and can affect delivery of LWD to watercourses based on past observations. Specific measures are applied to: (a) inner gorges, (b) headwall swales, and (c) areas of existing instability and deep-seated landslides. Proposed protective measures on these landforms are discussed below in terms of their potential for influencing delivery of woody debris to watercourses.

*Inner Gorges.* Inner gorge topography occurs throughout the action area. There are six (6) watersheds with anadromous fish present that have inner gorge slopes greater than 1 $km^2$ area of FGS lands. These watersheds are: Beaver, Cottonwood, Doggett, Empire, Horse, and Indian creeks (Chinook and coho salmon are not found in Indian Creek). The watershed with the highest occurrence of inner gorge slopes on FGS lands is Beaver Creek at 6.2 $km^2$ (FGS 2009).

In drainages with anadromy (Class A and B designated lands), where an inner gorge extends beyond a Class I WLPZ and slopes are greater than 55 percent, a special management zone (SMZ) will be established where the use of even-aged regeneration methods is prohibited, and a minimum average overstory canopy of 60 percent will be retained. The SMZ shall extend upslope to the first major break-in-slope to less than 55 percent for a distance of 100 feet or more, or 300 feet as measured from the watercourse or lake transition line, whichever is less. On Class A designated lands where an inner gorge extends beyond a Class II WLPZ, an SMZ will be established that extends upslope to the first major break-in-slope to less than 55 percent for a distance of 100 feet or more, or 200 feet as measured from the watercourse or lake transition line, whichever is less. All operations on slopes exceeding 65 percent within an inner gorge of a Class I or II watercourse shall be reviewed by a Professional Geologist (PG) prior to THP approval, regardless of whether they are proposed within a WLPZ or outside of a WLPZ.

As described previously, barring any major wildfire(s) in the HCP area over the life of the permit, the WLPZs established along Class I and Class II watercourses will provide for a high level of long-term LWD recruitment potential. Assuming that the canopy retention standards on Class I inner gorge slopes will result in retention of at least 60 percent of the existing trees, selective harvest within the SMZ will retain at least 60 percent of the potential LWD recruitment from the SMZ. In the event of a slope failure within the inner gorge, wood will be available to recruit as LWD to downslope receiving watercourses. Requiring geologic review of all operations on steep (>65 percent) slopes within the inner gorge will ensure that proposed activities do not present a greater risk of slope failure (sediment overloading is also a risk to salmonid habitat), and may require that harvest be restricted beyond the overstory canopy retention standards (e.g., recommended no-cut).

We do not anticipate that every inner gorge harvested on during the life of the permit will experience a mass-wasting event. However, there is a moderate probability that inner gorge slopes that have been harvested will fail post-harvest within the 50-year permit term. Should a mass-wasting event occur after trees have been harvested, there would be fewer trees available on the slope for recruitment to the channel, barring any other mitigating circumstances such as fires. Overall, we expect that the removal of trees from inner gorges slopes within those FGS anadromous watersheds with greater than 1 $km^2$ inner gorge area will result in some reduction of LWD recruitment to those watersheds over time. Harvesting according to the HCP standards on inner gorge features means wood with LWD recruitment potential is available over the life of the permit. Should inner gorge slopes fail during the permit term, we expect an influx of wood would be recruited to the stream with sediment and other debris, which may provide habitat-forming channel conditions in stream networks downstream of the inner gorge failure. Increases in channel complexity would provide improvement to covered species habitat within Class A and B lands via improvements in pool spacing, depth, and refugial conditions. In summary, we expect the level of HCP inner gorge protection to improve salmonid habitat overall where these features occur during the life of the permit. The degree of habitat improvement cannot be reliably predicted however as inner gorge failures are stochastic in nature, and failed features may or may not have LWD forming trees on them depending upon the history of landslide activity on the feature (*i.e*., existing failed inner gorges may have limited tree growth or young tree growth due to historical sliding).

*Headwall Swales.* Using computer models and field observations, trained and qualified personnel will identify headwall swales during THP preparation. Where harvesting is proposed on a headwall swale connected to a Class II or III watercourse, it shall be reviewed by a PG to ensure that proposed activities do not present a greater risk of sediment delivery from mass-wasting. Only the selection-regeneration method or commercial thinning-intermediate treatment may be utilized on connected headwall swales and a minimum average overstory canopy of 60 percent will be retained. Assuming that the canopy retention standard will result in the retention of at least 60 percent of the existing tree canopy, harvest within the headwall swale area will retain at least 60 percent of the potential LWD recruitment.

Initial reconnaissance efforts to identify headwall swales using a combination of *SHALSTAB* modeling and field verification suggest that headwall swales greater than a 1 $km^2$ area within a FGS watershed are limited to Beaver Creek (1.36 $km^2$), with other watersheds possessing only minor areas of headwall swales. Overall, headwall swales are not believed to occur in great frequency or area within the HCP area and any reduction in LWD recruitment potential from these unstable areas is likely to be minor over the life of the permit. Thus, over time implementation of headwall swale protection measures in the HCP will result in LWD being available to recruit to downstream watercourses.

*Deep-Seated Landslides and Earthflows.* Under the HCP, mapping efforts will be utilized to identify areas of deep-seated landslides and complex, slump-earthflow terrains on FGS lands (FGS 2009). Deep-seated landslides are large, multi-faceted geologic features that occur through movement of large blocks of soil and loosely structured bedrock formations. The failure plane for these types of large, gradually moving features typically occurs at soil depths greater than five (5) feet. These slides are generally larger than shallow landslides and move in complex directions (e.g., rotational-transitional, block slide). Deep-seated landslides are often characterized by PGs as either active (moving), or dormant (a historical slide no longer in a stage of active movement).

Earthflows are typically larger features than deep-seated slides and encompass larger masses of soil which move slowly downslope. Earthflows generally move as an incremental mass where rapid movements (large landslides) are not common. They are characterized by undulating and hummocky land features, leaning, split, and pistol-butted trees on the formation and numerous seeps and springs. Both deep-seated and earthflow complex slides are the dominant mass-wasting terrain type within the HCP area occurring primarily in metamorphic terrain with earthflow being relatively common in FGS's Klamath River Management Unit. Many of these larger features are actively delivering sediment to adjacent watercourses. Where larger trees exist on these landforms, they provide a source of LWD. In addition to providing habitat functions noted previously, the delivered wood provides the mechanism to locally store and moderate the effects of the landslide delivered sediment.

Any areas that may exhibit characteristics of deep-seated or earthflow features will be identified during THP preparation and evaluated by professionally trained personnel. Within these identified features, FGS will retain an uneven-aged stand structure within the slide mass and toe slopes of these features. A minimum of 60 percent post-harvest canopy shall be retained on the feature and a 30-foot EEZ will be applied above the head of the feature. Any harvest on the toe slopes of the feature will receive extra scrutiny by a PG or Certified Engineering Geologist (CEG). In order to minimize sediment-generating events, FGS will also implement protections to prevent loading slide material or toe slopes with excavation spoils, road fill, or surface runoff. Changes to the default conservation measures would occur under the direction of a PG or CEG who must determine that alternative conservation measures are as equally protective at minimizing the risk of mass-wasting which could impact watercourses, as the default measures.

The harvest of trees from these features will remove potentially recruitable wood over the life of the permit, and the removal of live trees from these areas may increase the potential for these areas to fail post-harvest. If a feature experiences a mass-wasting event post-harvest it will have less wood available for delivery than if harvest had not occurred. It is important to note that within the action area, slides on these features occur even without harvest and is a natural process. Some of the trees that were removed during harvest may have been large enough to moderate the effects of the sediment in the receiving watercourse by forming LWD which can provide some measure of capture and storage of sediment over time as previously discussed. We further discuss these interactions between wood and sediment in the *Integration and Synthesis* section that follows.

*Other unstable areas.* Slope instability may occur on hillslopes not considered in the above landforms. Identification of these areas is based on recognition of a number of field indicators of hillslope instability. These field indicators, if observed, suggest a hillslope that is at high risk of failure.

For areas showing evidence of active instability, FGS will limit timber harvesting by not clearcutting the feature. Harvest on these features will be under the assessment of a PG or CEG who must evaluate and determine that the proposed timber management activities will not present a greater risk of sediment delivery to watercourses. Among other things, this includes an evaluation of any new road and landing construction and the operation of heavy equipment on the unstable area. We are unclear on the quantities of wood that will remain post-harvest on these features as there are no default post-harvest tree retention requirements, and post-harvest tree retention will vary according to geologist's evaluations. We assume that the bulk of the larger potentially deliverable trees could be removed over the permit term as smaller trees are selected to be left for stability purposes. Since these areas will be delineated during the THP preparation process, and are based on existing evidence of instability, we reason that some of these features will fail and deliver sediment to a watercourse in the years following completion of the THP whether the failure is caused by the harvest or not. Such slides are likely to deliver wood and sediment to adjacent watercourses. It is possible that much of the woody debris that would moderate the effects of the sediment delivery could have been harvested prior to the slide. We further discuss this interplay between wood and sediment in the *Integration and Synthesis* section.

*Road Construction and Maintenance*

FGS has more than 1,300 miles of road in the plan area, including 349 miles in the Grass Lake Management Unit which does not provide habitat for covered species with the exception of Bogus and Willow Creeks. Of this total, FGS has sole responsibility for approximately 1,100 miles. Other roads in the plan area are either managed by the USFS or are a "co-op" road meaning there is a cooperative agreement between USFS and another party (e.g., FGS or Siskiyou County). Within the plan area the majority of these co-op roads are found in the

Beaver, Cottonwood, and Horse drainages. Use and maintenance of these co-op roads is addressed through Section 7 consultation between USFS and NMFS. Many of the roads in the plan area paralleling streams are key haul routes into the watershed and will be maintained for use over the 50-year term of the HCP. NMFS anticipates that less than one mile of new roads would be constructed per year during the term of the permit. Of this total, most new streamside roads would be for temporary one-time use only. Over time, the presence of streamside roads has likely decreased the overall supply of wood available to recruit to watercourses as trees are removed to construct roads. The area of roads within Class I and II WLPZs is very small compared to total road miles as improvements in harvesting technology (e.g., cable-yarding) over the years has allowed for fewer seasonal and tractor roads to access desired timber. Salvage of trees that fall across existing or new roads will be limited to the portion of the tree bole upslope of the road. Generally this wood is not harvested unless it occurs in quantities large enough to make a load; requiring that several large trees are available in a small area. Trees within WLPZs that are felled to facilitate stream crossing upgrades, provide cable-yarding corridors or for safety reasons that are greater than 6-inches diameter will be left on site providing for potential future wood recruitment; others will be yarded unless prohibited by other provisions of this HCP.

*Summary of Effects on LWD recruitment*

Streamside forest stands are recovering from a history of near stream harvest, mining and other impacts that were described in the environmental baseline. Class I WLPZ buffers under the HCP will allow for continued recovery of LWD recruitment processes, although we expect recruitment from the most distal sources, which comprise a small fraction of the wood recruited to channels, will remain somewhat impaired. How this lack of distal recruitment will influence habitat conditions will likely be minimal, given that the bulk of wood is expected to come from near-stream sources (e.g., first 75'). Longer-term monitoring proposed in the HCP will examine the changes in wood recruitment patterns.

Class II WLPZ buffers will provide for recruitment opportunities, but likely not from long distal sources (e.g., beyond 100'). Again, we expect that much of the functional wood that would otherwise be delivered to channels to originate from a distance within the proposed buffer widths, however, the lack of more distal sources will limit the quantity of wood entering the channel over the term of the ITP and beyond as trees attain larger sizes. We expect the dominant effect will be a change in how sediment is routed through these channels. This interaction is explored further in the *Integration and Synthesis* section that follows.

Class III WLPZ buffers will remove much of the larger wood that would potentially deliver to the adjacent channel. Retention of hardwood species and individual conifers that are considered "channel trees" will provide a limited supply of material, mostly smaller pieces, to these channels. Similar to Class II channels, the dominant effect will be changes in the sediment transport and storage dynamics occurring in these channels with the exception of steep Class III channels that connect directly to a Class I channel, Class IIIs generally do not provide significant sources of LWD to fish-bearing watercourses (May and Gresswell 2003, Montgomery 2003, Reeves et al. 2003, May and Gresswell 2004).

Mass-wasting measures, assuming that selection harvest will occur on many of the landforms, will allow for the removal of potentially recruitable wood. Should these features fail and deliver to a watercourse, they will lack the quantity of wood that would exist in the absence of harvest on these features. This reduction in wood supply will influence habitat conditions in the vicinity of the slide and immediately downstream. These various interactions of woody debris and sediment are discussed further in the *Integration and Synthesis* section that follows.

At small scales over the life of the permit, road construction along streams will present a localized reduction in wood supply. Although we do not expect extensive streamside roads to be constructed over the life of the ITP, where they do occur, they may preclude further LWD recruitment unless the road is removed and revegetation occurs.

### 6.1.2 Effects on Thermal Inputs and Stream Temperature Regimes

*Effects of altered stream temperatures on salmonids*

Increased water temperatures in streams is often associated with the removal of shade-producing vegetation (Thomas et al. 1993). The principal source of energy for heating streams derives from solar radiation directly striking the surface of water (Beschta et al. 1987) or increases in air temperatures adjacent to the wetted channel. The removal of overhead canopy cover results in increased solar radiation reaching the stream, which results in increased water temperatures (Spence et al. 1996, Beschta et al. 1987). Generally, the wider the channel, the taller riparian trees need to be in order to reduce exposure of the stream to long hours of solar radiation. Outside coastal fog zones, a lack of late-seral riparian conifers can result in significant stream heating. This becomes particularly problematic if surface waters are also shallow in a channel widened by an oversupply of sediment. Spence et al. (1996) reported that old-growth stands provided between 80 and 90 percent canopy cover from studies in western Oregon and Washington. Flosi et al. (1998) and CDFG recommended an 85 percent riparian canopy to properly shade streams that might be used by salmonids. The temperature increase in a stream is directly proportional to the area exposed to sunlight and inversely proportional to the volume of water in the stream. As a result, the effect of canopy removal on stream temperatures is greatest for small streams and diminishes as streams get wider. Based on their review of numerous investigations, Johnson and Ryba (1992) concluded that forested buffer widths greater than 100 feet generally provide the same level of shading as that of an old-growth forest stand. Other authors (e.g., Beschta et al. 1987, Murphy 1995) have also concluded that buffers greater than 100 feet provide adequate shade to stream systems. The curves presented in FEMAT (1993) suggest that 100 percent effectiveness for shading is approached at a distance of approximately 0.75 tree heights from the stream channel. Assuming a tree height of 160 feet (150-year old Douglas fir, site index 100; Lindquist and Palley 1963), this buffer width should be 112 feet to provide 100 percent shading effectiveness.

Streamside forests also influence air temperature which, in turn, influences water temperatures. Contiguous forested stands create a relatively cooler, more humid microclimate. As the width of the forested stand decreases, increases in air temperature and decreases in humidity have been documented (e.g., Chen et al. 1999, Ledwith 1996). Increases in air temperature have been noted up to 720 feet into an upland forest from the edge of a clearcut, while solar radiation, soil temperature, and soil moisture were influenced up to 270 feet (Chen 1991). Ledwith (1996) noted that the greatest changes in temperature and humidity occurred within the first 90 feet and suggested that buffer widths greater than this should be retained to avoid significantly altering the microclimate of a riparian zone.

### 6.1.3 Effects of HCP Implementation on Stream Temperatures

<u>*Riparian buffers*</u>

*Class I buffers.* We expect little, if any, harvest to occur within the inner zone of the Class I WLPZs. In Class A and B watersheds, the 85 percent overstory canopy retention likely mimics unharvested conditions. The 65 percent canopy retention in the outer zone would potentially allow for removal of individual trees which have the potential to influence microclimatic conditions in the WLPZ. The provisions for maintaining direct shading to Class A watershed pools may result in retention of individual trees. Further, the requirement that any harvest within 150 feet of a Class I watercourse have as an objective, the protection, maintenance or restoration of the beneficial uses of water, or the populations and habitat of coho salmon or listed aquatic or riparian-species, is an objective foresters will need to consider when proposing to harvest any trees within the Class I WLPZ. In addition, the requirement to retain the 10 largest dbh conifers per 330 feet of stream also means that trees providing large canopy areas (shading) are retained in addition to the overall canopy retention requirements.

Based on the above, we reason that shading of Class I streams will not be reduced through application of the proposed riparian measures. Since the greatest microclimate effects are noted within the first 100 feet of the buffer, we reason that the 150 feet width combined with very little harvest will retain climatic conditions near those experienced in unharvested settings. We expect that the size of harvest units (generally less than 40 acres) will preclude any detectable increases in stream temperatures as a result of the Class I buffer. Further, given the limited extent of Class I streams bordered by FGS lands, no more than 14.4 miles of mostly steelhead habitat, and the occurrence of federally managed forest lands adjacent to FGS lands where little harvest will occur, we expect that increases in temperatures from multiple harvests along Class I watercourses over the life of the permit will be undetectable. Over the term of the permit, stream temperatures in the action area will likely remain near current levels, or decrease as riparian stands grow and recover from past timber harvest practices.

*Class II buffers.* Class A and B watershed buffer widths along Class II watercourses will range from 50 to 100 feet, with Class A WLPZs always occurring to 100' and receiving greater canopy retention requirements than Class B WLPZs. Similar to what was discussed for Class I WLPZs, in Class A watersheds we expect little harvest within the buffer due to a combination of canopy retention and the provision for protection, maintenance or restoration of aquatic habitat conditions and other beneficial uses. We do not anticipate that harvest of Class II watercourses in Class A watersheds will result in any measurable increases in stream temperature in downstream fish-bearing watercourses. In Class B watersheds however, a reduction in WLPZ widths based on slope with a concurrent reduction in canopy retention to 50 percent may allow for increases in stream temperatures as harvest of up to half the shade producing trees may allow for elevated air temperatures adjacent to the WLPZ. This microclimate effect could result in increased watercourse temperatures. These temperature increases would mostly affect steelhead habitat and to a much lesser degree coho habitat as FGS lands in Class B watersheds are typically far upstream of coho distribution. However, if similar Class II harvest strategies are applied on downstream non-FGS lands, cumulative adverse temperature increases could occur in the Class B coho watersheds (Moffett and Bogus Creeks).

*Class III buffers.* Class III channels are not perennial and generally only flow during the winter and spring months following prolonged rainfall. Any watercourses with flow during the summer months when temperatures are an issue would be afforded Class II protections. Therefore, we do not expect any modifications to the stream temperature regime from the proposed Class III buffers.

*Summary of HCP Riparian Management Effects on Stream Temperatures*

Based on the HCP overstory canopy retention standards and riparian widths, NMFS expects that protection of riparian zones along Class I streams will result in negligible increases in water temperatures or a reduction in stream temperatures over time as tree growth takes place. Canopy requirements along Class II watercourses in Class B watersheds may not be sufficient to approximate undisturbed thermal conditions. Many Class II watercourses in the action area go dry at some point in the summer and the increase in watercourse temperatures may be short-lived and not affect downstream Class I watercourses for an extended period of time. Therefore, we expect some minor, localized increases in Class II stream temperatures that may influence temperatures in downstream, fish-bearing reaches. In these Class B watersheds, steelhead, which have higher thermal tolerance levels than coho, could experience some periods of higher stream temperatures, although our current understanding of stream temperatures in the action area (Table 10) do not indicate that temperatures approach lethal levels for steelhead. Temperature effectiveness monitoring in the Moffett Creek drainage should evaluate whether there is a relationship between increased temperatures, if found, and harvest strategies in this Class B watershed. Such a finding would require further assessment by FGS to determine the likely causes of the increased temperature findings. This monitoring will occur annually and may result in the ability to rapidly assess whether harvest is connected to increased water temperatures and provide the ability to make changes in the conservation strategy if warranted.

Given the Class I riparian protection measures, Class II riparian measures that will allow for temperature moderating riparian conditions with time, and the implementation of temperature effectiveness monitoring that will allow for detections between harvest and subsequent elevated temperatures, we expect the proposed riparian measures will result in no long-term adverse change in stream temperatures.

*Road Construction in Riparian Areas*

Road construction and reconstruction within the WLPZ would remove shade-producing canopy and introduce local microclimatic alterations. As noted previously based upon the FGS HCP, NMFS anticipates less than one mile of new roads per year will be constructed over the permit term. Although specific locations of these roads are unknown across the FGS ownership, we anticipate that out of the limited new road construction anticipated, very little will be constructed in WLPZ zones and as existing WLPZ roads are decommissioned and removed from the FGS road network, revegetation will occur on these roads increasing canopy cover over the permit term. New roads would likely be temporary and abandoned after completion of a THP as FGS has their permanent road network largely in place (FGS 2009). NMFS will have opportunities to review THPs prepared under the limitations of the HCP to determine the extent and nature of any proposed WLPZ road. Any concerns noted by NMFS staff on a proposed road can be relayed to the appropriate FGS staff for further discussion and necessary action. Once a THP has been completed, it is typical FGS practice to abandon temporary roads (i.e., pull crossings, place waterbars, placement of erosion control measures) unless the road will be utilized in a known subsequent THP. We expect that nearly all new roads with intrusion into a WLPZ would cross the WLPZ, rather than running parallel to the stream as parallel roads are strictly limited under the proposed HCP. The width of these roads would be on the order of 16 to 20 feet. We do not expect that this road width configuration will disturb the riparian canopy to such an extent that stream temperatures will increase.

*Summary of HCP Road and Riparian Management Effects on Stream Temperatures*

Global climate change is expected to raise summer air temperatures within the action area within the timeframe of the HCP (See Section 5.3.11). It is anticipated that this rise in air temperatures will also result in overall rising stream temperatures in the action area. Our review of the proposed riparian measures suggests that the narrowest buffers along Class II streams are most susceptible to this increase in air temperatures. The susceptibility of Class B Class II watercourses to air temperature micro-climate effects caused by harvest of up to 50 percent of available canopy cover may lead to localized warming of harvested Class II reaches that have the potential to influence downstream fish-bearing reaches. Where harvest occurs along multiple segments of a perennial Class II stream over a short period, or where the harvest is situated near the confluence with a Class I stream, elevated stream temperatures at a localized level could occur. The amount of Class II harvesting within a Class B watershed within a short period of time (e.g., less than a decade) is likely a large controlling factor in the potential for increasing water temperatures in fish-bearing reaches. The greater the Class II areas harvested, the greater the potential for a cumulative watershed temperature effect; however, effectiveness monitoring will be implemented to help determine if these conditions are developing and if necessary make changes in the HCP conservation strategy to reduce the HCP-related conditions that are causing the rise in water temperatures. NMFS and FGS will determine the causes and appropriate response collaboratively. The response of individual salmonids to potential temperature increases in Class B watersheds is discussed in the *Integration and Synthesis* section.

### 6.1.4 Effects of Sedimentation Processes

The delivery of sediment to streams can be generally considered as either chronically delivered, or more episodic in nature. Chronic delivery, or surface erosion, occurs through rainsplash and overland flow. Therefore, surface erosion often occurs associated with rainfall. In the action area more episodic delivery occurs in the form of mass-wasting events, or landslides that can deliver large volumes of sediment during large storm events. Mass-wasting is a much more infrequent process, occurring on the order of every few years in association with large storms.

*Current Sedimentation Processes.*

To assess the condition of sedimentation processes in the action area, we consider the characteristics of stream channels as an indicator of sediment supply. Stream channels respond to changes in sediment inputs through a progression of changes in channel morphology and substrate characteristics. Increased sedimentation from hillslope disturbances ranges from increased fine sediment on the streambed and in transport, filling of pools, widening of channels to channel braiding.

Extremely high rates of sediment delivery to low gradient watercourses can result in braided channels. Tributary confluences in the action area, including Beaver and Horse Creeks, show a propensity for braiding, suggesting that sediment loads from these watersheds are elevated. Information on the degree to which channels have widened in response to increased sediment inputs is scarce. Given the historic mining activities that have occurred throughout the action area and effects observed from these large-scale disturbances, many of the channels in the action area are likely widened to some degree. Data on pool frequency and depths (FGS 2009) suggests that sediment may be impeding suitable pool development, although the lack of LWD noted earlier should be factored into this as well. Data from subsurface substrate sampling (FGS 2009) suggests that fine sediment exceeds optimal levels for salmonid spawning and egg incubation. The presence of excessive fine sediment may also fill in the interstices of coarser substrate and reduce the amount of cover available to juvenile salmonids such as steelhead.

FGS (2009) presents the distribution of landslide-producing landforms across their ownership. The extensive road network across the action area also provides a steady supply of sediment to stream channels – particularly through surface erosion processes and hydrologically connected road segments. The various activities that influence the elevated sediment levels observed in the action area are discussed further in the next section where we review the various activities occurring in the action area and their contributions to various stressors.

*Roads and Sediment*

Throughout the HCP area, nearly 4,500 miles of roads have been identified, with about one-third (about 1,500 miles) of these roads on FGS lands (Appendix C). The remaining 3,000 miles of road are on lands controlled by the USFS, other governmental agencies, or other private interests. FGS is solely responsible for maintenance of over 1,100 miles of road in the HCP area. About 200 miles of road on FGS lands are co-operative roads (co-op roads). These roads are owned and controlled by the USFS, but are maintained jointly by two or more parties under a Road Right-of-Way Construction and Use Agreement. Under these agreements, construction and maintenance activities are shared between the cooperators (for example, FGS, Siskiyou County and the USFS). As these roads are under the jurisdiction of the USFS, they are constructed and maintained in accordance with USFS standards. The majority of co-op roads are found in the Beaver Creek, Cottonwood Creek, and Horse Creek planning watersheds and account for more than 40 percent of the road mileage on FGS lands in these planning watersheds.

The overall density of roads in the individual planning watersheds ranges from 0.6 to 5.9 miles per square mile ($mi/mi^2$). The highest watershed total (FGS and non-FGS) road densities are in the Doggett, Empire, Beaver and Lumgrey Creek watersheds in the Klamath Management Unit with a range of 4.5-5.8 $mi/mi^2$. In the Scott Valley Management Unit, Meamber, Patterson, and Indian creeks have the highest overall road watershed total road densities with a range of 4.2-5.9 $mi/mi^2$; average road density on the FGS ownership is 5.4 $mi/mi^2$. Within these watersheds, on the FGS ownership, road density generally ranges from 4 to 7 $mi/mi^2$ depending on the watershed. On FGS property alone, the highest road density in the Klamath Management Unit is Doggett Creek with 7.6 $mi/mi^2$; in the Scott Valley Management Unit it is 7.9 $mi/mi^2$ in the Pat

Ford watershed. These road densities for commercial timberlands are not unusual for the region. In general, as the density of roads in a planning watershed increases, the likelihood of road-related erosion and mass movement increases. However, many factors other than road density affect the likelihood that roads will contribute sediment to streams, including parent geology, road surfacing, type of road construction (such as cut-and-fill, full bench, and so on), proximity to streams, intensity and seasonality of use, and frequency and type of water collection facilities (Weaver and Hagans 1994).

Road stream crossings are known to be significant sources of sediment erosion on forested landscapes as crossings, if improperly constructed, can fail during storm events, plug and overtop washing out road fill, and be a source of chronic surface erosion. On HCP covered lands there are 49 crossings on fish bearing streams; forty (40) of these are located in the range of anadromy, 31 of which are currently passable, and nine (9) are not currently passable to at least one salmonid life stage. Of these 40 crossings, 16 are bridges, 13 are culverts, 9 are fords, and two (2) are decommissioned. Of the nine impassable crossings, five crossings form partial barriers, and four form temporal barriers (FGS unpublished data).

FGS has conducted comprehensive road inventories on their ownership in three planning watersheds. These inventories have been conducted using common methodologies to identify and prioritize sites with the potential to deliver sediment to area streams. Road improvements recommended during the inventories include surfacing, drainage improvement (shaping, sloping), traffic controls, decommissioning, stabilization of slumps and slides, and upgrading stream crossings (bridges, fords, culverts).

Hydrologic connectivity of roads on the FGS ownership was reported for the Doggett and Cottonwood drainages. Connectivity was reported as 13 percent in Cottonwood (4 miles) and 14 percent in Doggett (7.6 miles). Many of the connected sites are in the form of inside ditches located on USFS Cooperative road segments over which FGS has no jurisdiction. The remainder of connected segments consists of short segments located at stream crossings.

Through periodic inventory and assessment efforts, FGS has targeted the high-potential sediment delivery road sites for improvement projects, and road improvement projects have been completed in several planning watersheds, as described in Appendix D.

*Effects on Sediment Generation and Delivery*

*Baseline conditions.* Sediment has impacted streams in the action area in numerous ways. Legacy effects from mining activities radically altered stream channels, many of which are still recovering today. Decades of timber harvest has resulted in widespread sediment delivery from numerous sources. Agriculture in the valley bottoms has led to increased bank erosion and delivery of sediment from fields and pastures. The mainstem Klamath River experiences altered sediment transport dynamics due to the upstream dams.

Under current land management practices, sediment delivery can be generally characterized as either episodic or chronic. Episodic sediment delivery is driven principally by hillslope and road landsliding during large storms. Chronic sedimentation is driven by frequent rainstorms which generate sediment from exposed surfaces such as roads, bare landslides and agricultural activities which expose bare soil. In general, episodic events deliver a wide range of sediment particles (e.g., boulders/cobbles down to fine silts and clays) depending on the parent geology. Chronic sediment, on the other hand, usually delivers smaller sized particles as the erosion occurs at the soil surface (e.g., native roads). Our review of information from the action area suggests that levels of fine sediment in the smaller streams of the action area are often above suitable levels for salmonid reproduction. This preponderance of fine sediment suggests that chronic erosion processes are likely a significant factor in the action area.

*Effects of sediment on salmonids and their habitat*
Chronic delivery of sediment, typically fine sediment, can have several different impacts, both directly on salmonids and their habitat, and via more indirect means such as effects on prey base. The following discussion on the effects of chronic sedimentation and turbidity is largely taken from a more comprehensive summary by Spence et al. (1996).

Chronic siltation of streambeds may reduce the diversity and densities of aquatic macroinvertebrates used as a food source by salmonids. Turbidity can adversely affect fish at every stage of their life-cycle. When concentrations are sufficiently high, suspended sediment can cause gill abrasion. Sediment deposited on the streambed reduces the amount of interstitial cover available to juveniles. Excessive siltation of spawning gravels leads to reduced juvenile emergence success, suffocation of fry, and entombment. Turbidity affects light penetration, which, in turn, affects the feeding abilities of salmonids. When turbidity levels are persistently elevated, juvenile growth rates may be suppressed due to the poor feeding conditions.

Mass-wasting is a principal mechanism for the delivery of sediment to stream channels. Once in the stream channel, the quantity and rate of sediment supply is a dominant factor in the distribution and quality of habitat for Pacific salmonids (Reeves et al. 1995). Excessive rates of sediment supply are manifested as increased levels of fine sediment in the streambed, widened channels, filled pools, and, in the case of extremely high sediment yields, widened and braided channels (e.g., Dietrich et al. 1989). This occurs when an oversupply of sediment fills the existing channel width, decreasing vertical volume capacity, which causes water to move laterally rather than vertically during storm events, eroding sideslopes, which allows for new thalwegs to be formed, which appears as braiding within the full channel width. In terms of salmonids and their habitat, these physical changes lead to: reduced spawning habitat quality, reduced interstitial spaces for juvenile cover, decreased diversity and abundance of aquatic invertebrates, decreased pool volumes for juvenile rearing and adult holding, lack of stable spawning habitat and shallow or dry reaches that present access problems to migrating fish (e.g., Spence et al. 1996).

Based on the physical responses of channels and stream habitat to mass-wasting, salmonids would experience effects associated with increased sedimentation including reduced reproductive success as a result of reductions in survival-to-emergence rates (e.g., Spence et al. 1996). The emergence of salmonid fry would be reduced due to unstable substrates, fine sediment reducing gravel permeability and oxygen carrying capacity, and entombment. Juvenile salmonids would be exposed to greater competitive pressures due to a lack of adequate habitat quantity and quality, and, as a result, experience reduced growth rates, increased predation and mortality.

*Effects of HCP Implementation on Sediment-related Processes*

*Road use, construction and maintenance*

*Road use.* Within the plan area FGS road use will cease when precipitation results in overland flow off the road surface, rutting occurs, or a stable operating surface cannot be maintained. Road use will not resume until a stable operating surface can be maintained. We expect that these provisions for road use will curtail vehicle use for timber harvest related activities during wet weather periods. However, since the FGS road network is largely intermixed with the public lands roads network (USFS) all vehicle use will not cease during periods of wet weather. During mid-winter, much of the road system may be inaccessible due to snow, but early and late season storms as well as warmer, mid-winter periods could see vehicle use occurring.

Given the seasonal restrictions on road construction and upgrading and the wet weather provisions mentioned above, we do not expect heavy equipment to operate on the FGS road network during the winter months. We expect that most road-use related sediment will be delivered early and late during the wet season. Combined with the measures for hydrologically disconnecting the road network and rocking of sensitive crossing approach areas will allow for a reduction in fine sediment generated from the road network.

The provisions for maintaining a stable operating surface would likely allow for grading of the road surface to remove a saturated or rutted surface layer. This practice has the potential to increase fine sediment delivery by exposing unarmored road fill to surface erosion processes.

*Construction.* Construction of roads can influence sediment generation depending on the time of year the road is constructed and potentially exposed to erosion inducing rainfall events, as well as the location and drainage characteristics of the new road. Construction or reconstruction of logging roads, tractor roads, or landings will not occur October 15 to May 1 for Class II or III streams, or October 15 to June 15 for Class I streams, unless approved via a winter operating plan in the appurtenant THP. The winter plan must provide that such activities must not produce visibly turbid water reaching a watercourse, meaning high-level erosion control devices must be incorporated into the activity to achieve this standard. In addition, all new and reconstructed roads will be outsloped where feasible and drained with waterbreaks and rolling dips allowing for minimization of concentrated road surface runoff in inside road ditches and ditch relief culverts (DRCs). This minimization should reduce erosion along inside ditches and DRC outfalls.

Within Class A watersheds new road construction or reconstruction including new watercourse crossings within Class I or II WLPZs will need to demonstrate that the proposed construction provides more aquatic protection than an alternate route outside of the WLPZ. There are times when it is actually less protective to build a new segment of road outside a WLPZ than to build or re-use a small segment of road within a WLPZ (e.g., building a new road requires excavation through the toe of an active unstable area.).

For new or reconstructed crossings, the use of culverts that accommodate the 100-year peak flow and associated debris and sediment (refer to Cafferata et al. 2004 for detailed discussion of culvert sizing strategies) will likely result in very infrequent instances of stream crossing failures due to plugging and/or overtopping. In addition, the HCP road management plan will result in the gradual reduction of active road mileage across the plan area, meaning more pre-existing crossings will be pulled and decommissioned than will be installed at higher standards. All new permanent culvert crossings shall allow for the unrestricted passage of all life stages of fish in addition to meeting the 100-year flow requirement. Existing culverts will be removed and replaced (if necessary) if they are crushed, perforated, piping, separated, located on unstable fill, may be causing erosion expected to deliver to I, II, or III watercourses, or not adequate to carry 50-year flows.

*Road maintenance and upgrading.* Two tiers of effort are proposed here. The first is more routine maintenance and inspection activities. This will be ongoing over the term of the ITP. The second effort will be a watershed-by-watershed inventory, assessment, and treatment of road-related erosion issues.

FGS proposes a schedule for periodic inspection and maintenance of the road network. Inspections would regularly occur ownership-wide with greater frequency where THPs are in operation or a triggering storm occurs. We expect the periodic maintenance and inspection efforts outlined in the HCP will assist in recognizing and correcting potential erosion hazards and will aid in reducing culvert blockages that cause catastrophic failures. Routine and emergency inspections and work (e.g., unblocking culverts, brushing, spot rocking) may be completed during the winter and spring if necessary to prevent water diversions and fill failure or avoid damage to property.

Heavy equipment might be used in the stream for these emergency activities. If equipment is used in the water, there could be short-term direct effects to salmonids and designated critical habitat from these activities including destroyed redds, smothered or crushed eggs and alevins, increased turbidity, blocked migration, and a disruption or disturbance of overwintering juvenile and adult salmonids. Pacific salmonids are particularly vulnerable during the winter, when adult salmonids are migrating and spawning, and the spring, when eggs and fry are still present in the substrate. The activities could scare juveniles out of overwintering habitats such as side channels and deep pools, into inferior habitats or high velocity waters. Impacts incurred due to emergency activities during the winter are likely to be localized and short-term, but may be locally intense, especially if redds are destroyed. With the assessment and stabilization schedules established in the HCP, we expect these types of emergency actions to be relatively rare and localized. Over time, as roads and stream crossings are upgraded to the specifications required in the HCP, the necessity for winter and spring emergency stabilization work should decline. The short-term impacts would be further offset by the immediate and long-term benefits provided from stabilizing fill, preventing culvert blow outs, and minimizing erosion problems.

FGS also proposes a series of road inventory and assessments to prioritize road-related sediment reduction efforts. FGS proposes to remove at least half of the potentially deliverable sediment from roads (based on a prioritization process and schedule further described in the HCP) in Class A watersheds. Within the first 10 years of permit issuance, FGS will inventory and treat sites with potential sediment delivery in the top five anadromous drainages in the Klamath River Management Unit (Beaver, Horse, Cottonwood, Empire, and Dutch). Other important watersheds (e.g., Moffett) are expected to complete the 50 percent sediment treatment program by the end of 15 years.

We expect that some road treatments (e.g., culvert replacement) to reduce long-term sediment delivery potential will themselves likely result in delivery of sediment to watercourses post - construction. Adverse effects to covered species and their habitat due to road treatment work are caused primarily by inputs of fine sediment and crushing by equipment crossing the wetted channel where fish are present at the time of road work. We expect these adverse effects to be relatively short-lived with the greatest effects occurring during the first storms following the activities and diminishing within approximately two years as revegetation and channel adjustment occurs. Turbidity generated by instream equipment could settle on downstream redds, smothering or impairing the ability of fry to emerge from gravels. However, seasonal restrictions and requirements for erosion control on site will reduce sediment coming off the worksite reducing the exposure potential to eggs and alevins which may be present in the substrate downstream of worksites. During the summer months, the possibility of a juvenile or adult salmonid being crushed by instream equipment use is considered remote, due to their flight response which causes juveniles to move to deeper water when disturbed (Knudsen et al. 1992). Also, as the plan area includes very limited areas where FGS roads are located near Class I streams, we expect that much of the treatment work will occur on upslope areas, away from fish-bearing stream reaches. We also expect road treatments will be implemented gradually over a period of one to five years and across multiple watersheds, thereby reducing the likelihood of large pulses of construction-related sediment over short periods of time.

*Summary*
We expect that the road measures over the life of the HCP will reduce road-related fine sediment inputs. This is based on the amount of road that we expect to be hydrologically disconnected from the channel network and our best estimate of the effectiveness of these treatments. At many individual sites, reductions in sediment delivery may approach 100 percent, while other sites may remain persistent sources due to their proximity to streams and lack of practical treatments short of relocating the road. Impacts to salmonids or designated critical habitat could occur during the period between permit issuance and treatment if road sites fail and deliver sediment into waters before they can be fixed. However, we believe sediment delivery will occur at lower rates and quantities within the first 15 years than would be expected without implementation of the HCP.

Overall, implementation of the HCP is expected to reduce the delivery of fine sediment to watercourses and instream salmonid habitat within the plan area. We expect this will allow for a gradual improvement of instream habitat over the life of the HCP as the road treatment schedule and road management plan are implemented. However, unavoidable continued delivery of sediment into watercourses from normal road use, maintenance activities, and treatment of priority road sites under the HCP will still result in some level of impacts to habitat quality and salmonids.

*Mass-wasting hazards*
*Headwall Swales.* These are areas of steep (typically greater than 65 percent), convergent topography that is connected to a watercourse by way of a continuous linear depression. Headwall swales are typically perched above the initiation of low order, Class II or III channels. We expect the default 60 percent canopy retention standards proposed for headwall swales will retain much of the root strength that provides cohesion to the hillslope. Where a 60 percent overstory canopy does not exist, harvest is prohibited.

We do not expect these features will fail due solely to harvesting except in infrequent events. As these features are relatively rare within the plan area, we expect that over the term of the permit, harvest on these features is not likely to generate significant sediment delivery. Given the combination of the low abundance of these features within the plan area along with fairly conservative harvest limitations, we anticipate little sediment delivery from harvest on headwall swales.

*Inner Gorges.* These streamside hillslopes are widely recognized as a common site of landsliding and delivery of sediment to stream channels and occur in the action area. In Class A watersheds proposed harvest on inner gorges on Class I, II, and III watercourses will receive both review by a PG as well as receive default harvest prescriptions; 60 percent overstory canopy retention for all watercourse classes in Class A lands. These protection measures will be applied in the zones most susceptible to failure (based on slope and watercourse class). Requiring geologic review of all operations on steep (>65 percent) slopes within the inner gorge will also help ensure that proposed activities do not present a greater risk of slope failure and may require that harvest be restricted beyond the overstory canopy retention standards (e.g., recommended no-cut).

We do not anticipate that every inner gorge harvested during the life of the permit will experience a mass-wasting event. We expect the canopy retention standards proposed for inner gorges will retain a portion of the root strength that provides cohesion to the hillslope. However, there is some probability that an inner gorge slope that has been harvested will fail post-harvest. The provisions for geologic review prior to any harvest on inner gorge slopes greater than 65 percent combined with the minimum canopy retention will help to ensure that root cohesion is maintained on these steep slopes. NMFS will have the opportunity to review and evaluate the outcome of FGS' geologic review and recommended harvest on inner gorge slopes prior to the harvest occurring. Over the long term, we expect isolated instances where inner gorges may fail due to harvest, either on the feature, or the slopes above it. This likelihood is highest in the watersheds with the greatest number of inner gorges present (Beaver, Cottonwood, Doggett, Empire, Horse, and Indian creeks).

*Existing unstable ground and deep-seated landslides.*
Both deep-seated and earthflow complex slides are the dominant mass-wasting terrain type within the plan area occurring primarily in metamorphic terrain with earthflow being relatively common in FGS's Klamath River Management Unit. Many of these larger features are actively delivering sediment to adjacent watercourses.

A default harvest prescription of 60 percent post-harvest canopy will be retained on these features and a 30-foot EEZ will be applied above the head of the feature. Any proposed harvest on the toe slopes of the feature will receive extra scrutiny by a PG or CEG. Changes to the default conservation measures will have to be under the direction of a PG or CEG who must determine that alternative conservation measures are as equally protective at minimizing the risk of mass-wasting which could impact watercourses as the default measures.

In forested terrains in the action area, mass-wasting is the primary cause for the delivery of sediment to stream channels. In the action area, excessive sedimentation, due principally to mass-wasting from both roads and hillslopes, has over a long period, decreased the quality of available spawning and rearing habitat. Based on the physical responses of channels and stream habitat to mass-wasting, salmonids would experience effects associated with increased sedimentation including reduced reproductive success as a result of reductions in survival-to-emergence rates (e.g., Spence et al. 1996). The emergence of salmonid fry would be reduced due to disturbances in channel substrate and fine sediment reducing gravel permeability and entombment. Juvenile salmonids would be exposed to greater competitive pressures due to a lack of adequate habitat quantity and quality, and, as a result, experience reduced growth rates, increased predation and mortality.

Episodic landslides that deliver large volumes of sediment into fish-bearing reaches from FGS roads or FGS hillslopes could also result in direct take of individuals by the smothering of redds or burying of fry, juveniles, and to a lesser potential, spawning adults. Large landslides, such as debris torrents, can happen rapidly and almost instantaneously deliver large volumes of sediment to a salmonid stream. When this occurs there can be significant localized impacts if the landslide covers available spawning habitat in the watershed. Although there are measures in place to minimize the potential for harvest-related landslides to occur with the plan area (e.g., inner gorge protections and geologic review of unstable areas), we anticipate there will be some instances of these types of episodic landslides throughout the duration of the permit where there is a direct correlation between covered activities and the landslide. We expect these landslides will result in localized direct take of redds, juveniles, and a small probability of adults.

*Summary*
Over the short-term, landslides from hillslopes within the plan area could continue to occur as a result of past, present, and future management practices in addition to naturally occurring landsliding not related to covered activities. Given the inherent sensitivity of hillslopes to disturbances (natural or human-caused), the role and integrity of professional geologic review outlined in the HCP is important to ensure that harvest-related impacts do not result in the need to reconsider permit requirements consistent with the ESA Section 10(a)(1)(B) regulations, and the terms of the IA. For example, during THP reviews mass-wasting areas may be identified and protections recommended by reviewing agencies. While we do not possess information to assess the level of site-specific professional geologic review all plans will receive, adequate review and oversight by a qualified PG should help ensure that mass-wasting hazards are recognized and minimized prior to vegetation removal and earth-moving. Furthermore, we anticipate that the geologic review in the HCP will not substantially change harvest in these areas because the HCP specifies a geologist's alternative prescriptions must provide equal or greater protection relative to default prescriptions.

Finally, FGS will implement a mass-wasting assessment at the end of 15 years of HCP implementation. The objective of the assessment will be to determine if there is a relationship between mass-wasting processes and forest management practices. This assessment will help to address whether covered activities are resulting in mass wasting rates above regional background rates, and whether the mass wasting conservation measures in the HCP are effective at minimizing mass wasting events. If not, changes in HCP conservation measures to increase effectiveness will be considered as part of an adaptive management strategy. Given the long response times of mass wasting to timber harvest, due primarily to root decay and the occurrence of triggering storms, we expect that meaningful modifications to the mass wasting provisions will not occur until at least 15 years into the HCP following the preliminary results and the effects of any changes as a result of this assessment will not be realized for several years afterwards. Therefore, we anticipate the current mass wasting minimization and avoidance strategy may remain unchanged across the landscape for at least the first 15 years of the HCP unless certain provisions of the IA triggers such changes. The risk this presents to instream habitat and Pacific salmonids is discussed in the *Integration and Synthesis* section.

*Harvesting and Surface Erosion*
The HCP will include several measures FGS will implement to minimize the generation and delivery of fine sediments from harvest units to stream channels. In general, these measures focus on tractor, skidder and forwarder operating restrictions in WLPZ's, prescribed fire objectives, EEZs, fireline construction measures, and bare soil exposure measures.

Logging systems, silvicultural operation and site preparation can result in compacted soils from heavy equipment operations and disturbed soil cover. Compacted and bare soils can result in an increased potential for overland flow and dislodging of sediment which can become transported during storm events to stream channels. This source of harvest-related sediment from surface erosion is likely to transport the first year or two following harvest or site preparation, and may continue to a lesser extent until revegetation of the exposed sites. The HCP will minimize this potential by requiring disturbed areas to be treated for erosion control utilizing methods such as the application of mulch, slash, rip-rap, or grass seeding to provide a barrier between precipitation and exposed bare soil. In addition, harvested sites are required to meet stocking standards a few years after harvest requiring many clearcut sites to be planted post-harvest. As vegetation (natural or planted) grows in the harvested area, soil loss lessens during rain events; it may take up to five years for a harvested site to become completely vegetated.

*Summary*
We expect that harvest-related surface erosion will be a relatively minor component in the overall delivery of sediment to streams. In quantifying sediment sources in a coastal setting, PALCO (2001) found that harvest-related surface erosion accounted for 4 percent of the total surface erosion inputs. The greatest proportion of surface erosion was generated from roads. Additionally, the provisions for avoiding all timber operations during the winter period (October 15 – May 1 or June 15) unless a complete winter operating plan is incorporated) will limit the amount of fine sediment that is generated during harvest operations. In general, effects to salmonids from this source of sediment delivery are the same as described for roads.

### 6.1.5 Effects on the Hydrologic Regime

Numerous stream reaches in the action area suffer from altered streamflows. Flows in the mainstem Klamath River are heavily influenced by releases from upstream reservoirs – creating poor conditions for multiple life stages of salmonids. Other large streams such as the Scott and Shasta Rivers are faced with extremely low flows from late spring through fall as a result of the cumulative effects of multiple agricultural diversions and water withdrawals. Many of the streams draining the FGS ownership are relatively uninfluenced by diversions and provide valuable refugia during low flow periods when other reaches are unsuitable for salmonids.

Timber harvesting activities can have significant effects on hydrologic processes that determine streamflow. Timber harvest and road construction alter runoff by accelerating surface flows from hillsides to stream channels (Chamberlin et al. 1991, McIntosh et al. 1994). These accelerated flows increase peak flows during rainstorms (Ziemer 1998). Also, removal of vegetation reduces evapotranspiration, which increases the amount of water that infiltrates the soil and ultimately reaches the stream. As a result, streams draining recently logged areas may see increased summer flows (Keppeler 1998).

*Effects of HCP Implementation on the Hydrologic Regime in the Action Area*

*Rate of Timber Harvest*

Effects of harvest will be greatest where harvest is concentrated in one watershed over a relatively short time period. As the FGS HCP also identifies a conservation strategy for the federally threatened northern spotted owl (*Strix occidentialis caurina*) that allows for the harvest of currently restricted timber stands ("take sites") in exchange for long-term protection of Conservation Support Areas (CSAs), which are, in general, on FGS lands located near Forest Service lands, timber harvest in the first decade of the permit will likely occur in watersheds where take sites have been authorized. Anadromous watersheds which may have greater than 30 percent potential maximum harvest of total drainage in any decade are the following: Doggett (decade 5), Empire (decade 1), Meamber (decade 1), and Patterson (decade 1). In all of these watersheds, FGS owns a large percentage of the entire watershed. These numbers are a potential maximum harvest rate; however, caution should be applied in these interpretations as rates of harvest would be largely governed by economics (up or down timber market) rather than simple availability of timber. It is also unknown whether harvest is intended to be spread out over ten years or whether maximum harvest is targeted for a short time frame (e.g., several years). If maximum harvest were to occur over a short timeframe rather than being spread out over ten years, adverse hydrologic affects may occur in the form of increased surface runoff and peak flows, increased potential for mass-wasting events, increased rates of streambank erosion, and increased potential that water temperatures in the watershed could rise if significant areas of Class II riparian habitat are harvested. All of these effects could adversely affect habitat for covered salmonids. The timeframe for harvesting at maximum rates cannot adequately be predicted as the lumber economy plays a significant factor in the statewide timber harvest rates. As of the date of this Opinion, the value of timber (mbf) in California is dramatically lower than highs reached in the mid-1990s (California Board of Equalization 2012). When timber prices are very low, it becomes more difficult to make timber harvest a profitable venture for private landowners. For this Opinion we have assumed that maximum harvest rates of greater than 30 percent of the entire watershed could occur in the Dogget, Empire, and Meamber creek drainages in a relatively short timeframe should timber prices return to high historical levels within any given decade during the life of the permit. Even with the HCP conservation measures for timber harvest applied in these drainages, we have made an assumption that there would be increases in peak flows following harvest at maximum rates allowable.

*Road Construction, maintenance and upgrading*

FGS anticipates that new road construction throughout the HCP area will average less than one (1) mile per year (FGS 2009) in a given area. This average includes HCP lands that do not provide habitat for anadromous fishes such that the average for watersheds where anadromous fish occur is less than the 1 mile/year estimate. At the same time FGS will be building some new roads, they anticipate decommissioning many seasonal roads such that there will be a gradual decline in active road densities over the life of the HCP (FGS 2009). We expect there may be small localized increases in peak flows associated with new road construction. We anticipate these effects will be reduced as roads are constructed according to the proposed guidelines in the HCP and other roads are treated for significant reduction in erosion potential and taken out of the FGS road network. Although altered peak flows still occur due to past and ongoing activities, the increase in peak flows from roads will be small, due to the proposed road construction and upgrading guidelines that call for hydrologically disconnecting much of the road network over the life of the HCP. Since much of the road network across the ownership has already been constructed, we anticipate that the effects of road-related peak-flow increases will diminish over the life of the HCP as roads are upgraded to HCP standards.

### 6.1.6 Effects on Habitat Access

The role of large dams and diversions throughout the action area in relation to access to suitable salmonid habitat was discussed in the environmental baseline section. With a few exceptions, the streams draining the FGS ownership are free of artificial barriers. Road-related migration barriers are present in some watersheds and where FGS has control over these sites, they are discussed below.

*Potential Effects from Covered Activities*

Culverts installed in fish-bearing watercourses may be impassable to both adult and juvenile fish migrating upstream due to 1) high velocities at the inlet, outlet or within the culvert, 2) a high entrance jump into the culvert outlet, 3) shallow water depths, or 4) lack of resting pools at the culvert inlet, outlet, or within the culvert. The potential effects of these barriers on adult fish include delaying access to spawning habitat and forcing fish to spawn is less suitable habitat. Effects to juveniles include blocking access to rearing and refugia habitat (e.g., upstream movement to cooler reaches).

*Effects of HCP Implementation on Barriers to Fish Movement*

During the road inventory process outlined in the HCP, fish passage problems at existing watercourse crossings will be documented and culverts that are impeding fish passage will be prioritized for replacement with a “fish friendly” structure. As the road management measures are implemented over time, the few remaining fish passage problems at watercourse crossings on the FGS ownership in the HCP area will be eliminated. We do not expect that new barriers will be created as a result of any new road construction and implementation of the HCP.

### 6.1.7 Effects on Nutrient and Contaminant Flux

Nutrient dynamics in the mainstem Klamath River are well documented and form a complex web of interactions which include impaired water quality and increased disease prevalence. In the smaller streams in the action area, agricultural activities likely result in localized inputs of nutrient enriched water although there are no large-scale agricultural operations (e.g., confined animal feeding operations) within the action area that could contribute significant nutrient loading into any particular watershed. In the forested areas, nutrient dynamics are likely similar to unmanaged settings given the presence of a forested canopy along much of the stream network.

*Effects of altered nutrient and contaminant delivery on salmonids*

Productivity of salmonid streams throughout the Pacific Northwest and Northern California is thought to be naturally limited due to low levels of nitrogen (Allan 1995; Triska et al. 1983).

With the exception of the mainstem Klamath River, the primary productivity of streams within the action area is also likely driven by allochthonous (derived from outside the aquatic system typically through detrital material inputs). In addition, primary productivity of lower order channels may also be limited by light (Triska et al. 1983). Where present, hardwoods are one of the most important sources of detrital inputs to lower order streams (Murphy and Meehan 1991). Hardwood leaves rapidly decompose in the stream, providing a source of nitrogen for primary productivity. Conifer needles take longer to decay and have far less nitrogen. Woody debris, even twigs and small branches, has limited nutritional value to streams because it decays so slowly and is very low in nitrogen (Murphy and Meehan 1991).

Timber harvest in riparian areas can affect productivity of streams in several ways. First, nutrients may increase in the first few years following logging in riparian areas if logging opens stands to increased levels of sunlight (Hicks et al. 1991). Where summer stream temperatures are not stressful, increases in sunlight reaching the stream may result in increased algal production which can increase the abundance of invertebrates, which in turn, can increase the abundance and growth rates of predators such as juvenile salmonids which can increase nutrients through excretion and mortality (Wilzbach et al. 2005; Murphy and Meehan 1991).

*Effects of HCP Implementation on Nutrients and Contaminants*

We expect little change in the nutrient dynamics due to implementation of the HCP. The proposed riparian measures in the HCP will likely retain the characteristics of vegetation near Class I and II watercourses. Over the long-term, conifers may begin to out-compete streamside hardwoods and result in a gradual reduction in nutrient inputs to the stream. However, this would not result in the total elimination of hardwoods from the riparian areas as hardwoods such as alders and maple are a natural component of frequently flooded stream systems in the action area. The natural disturbance regime across the action area which includes mass-wasting, flooding, and fires, will ensure that colonizing hardwood species always form a component of the riparian vegetation community. Similarly, and as described above in regards to stream temperatures, the Class I and II WLPZs over time, will provide a level of shading to streams that approximates those found in older, conifer-dominated stands. As a result, measurable increases in the amount of sunlight reaching Class I streams is unlikely and the level of primary productivity is expected to remain essentially unchanged.

The use of petroleum products as fuel and lubricants in machinery and equipment in connection with other covered activities (potentially injuring or killing fish and incubating eggs in the event of incidental or accidental drips and leaks) could also harm large groups of individuals or entire stream segments. Equipment exclusions around Class I, II, and III watercourses specified in the *Aquatic Conservation Program* of the HCP will minimize the potential for hazardous materials from incidental leaks or drips from heavy equipment reaching a stream. Preventative measures to keep equipment-related contaminants (petroleum based products) out of streams are incorporated into the *FGS Road Management Plan – Operations Manual*. Even with these preventative measures in place, we do expect that over the course of the 50-year permit there will be some isolated accidents that may result in petroleum products spilling into a stream in the action area. We expect that such accidents will be of small-scale and result in a small area of stream being contaminated for a brief period of time (days). If salmonids are present at the spill site they may be exposed to harmful levels of contaminants that results in acute exposure and mortality of adults, juveniles, or both. We anticipate these events would be rare, but could result in short-term impacts to individuals and habitat.

### 6.1.8 Direct Mortality from Proposed HCP Activities

*HCP activities with the potential for direct mortality*

In addition to the above indirect effects on covered species that may result from habitat changes, there are covered activities that have the potential to cause two types of direct effects to the covered species. Activities with the potential to harm single individuals or small groups of individuals include operation of heavy machinery in streams during covered activities such as construction of watercourse crossings or stream enhancement work (potentially injuring or killing adults, juveniles, larvae, and/or eggs of the species). Other activities such as drafting of water from streams for dust abatement (potentially injuring or killing individuals suctioned up with the water and potentially damaging or destroying the incubating eggs of such species) and large landslides have the potential to harm larger groups of individuals.

*Effects of HCP Implementation on Direct Mortality*

We expect that the potential for direct effects to individual covered salmonids through operation of heavy machinery in streams during covered activities would be minimal. Via submittal of THPs that NMFS can review and provide input on prior to harvest, FGS would operate equipment in the wetted channel at pre-approved designated skid crossings from five to 10 crossings per THP with up to 12 uses of the crossings on each of perhaps 5 THPs per year for a total of 30 to 60 uses of THP stream crossings per year within the action area (FGS 2009). Skid crossings are not located on Class I (fish-bearing) streams. Road construction and maintenance activities may require in-channel work up to 40 times a year. The Draft *FGS Road Management Plan – Operations Manual* includes specifications for design and maintenance of stream crossings, work windows, and erosion control, including best management practices (BMPs) for construction and maintenance of stream crossings to minimize sediment impacts to watercourses during such activities.

Water drafting is another covered activity that presents the potential to directly affect individual fish during the drafting activity. FGS will conduct water drafting under strict guidelines as outlined in the HCP. These drafting guidelines conform to NMFS' water drafting guidelines and shall include measures such as location identification, yearly timing, estimated total volume needed, estimated total uptake rate and filling time, and associated water drafting activities from other THPs. Where FGS plans to draft from Class I or II streams where flows could be negatively affected, pool volume could be reduced by more than 10 percent, or a diversion rate could exceed 350 gallons per minute, FGS will not be drafting water unless they develop a water drafting plan subject to review by CDFG for permit purposes, and approved by the Director of the California Department of Forestry and Fire Protection ("CALFIRE"). Such a plan could include the issuance of an enforceable Streambed Alteration Agreement which can be reviewed by NMFS to ensure compliance with drafting guidelines. Other measures to be implemented in THPs to reduce impacts to salmonids include screening of intake structures to prevent entrainment or impingement of all life stages of fish and rocking approaches to drafting locations to avoid generation of sediment to the affected watercourse during drafting operations.

## 6.2 Interrelated and Interdependent Actions

### 6.2.1 Effects of Herbicide and Insecticide Use

The application of forest chemicals to control vegetation and damaging insects is not a covered activity in the HCP, but we consider it to be interrelated and interdependent with the HCP. Both direct effects from exposure and indirect effects from the alteration of habitat or changes in primary and secondary production may occur within the action area. Accordingly, the effects of herbicide and insecticide applications that are reasonably foreseeable during the course of HCP implementation are considered in this analysis. Table 14 gives a listing of forest chemicals used by FGS within the action area to control vegetation and damaging insects.

The contamination of surface waters by herbicides, and the resultant risk of toxic effects on salmonids, depends on the form and application rate of the chemical, the application method, soil type, weather conditions during and after application, the presence of riparian buffers, and the distance of the application area from flowing water. The persistence of these chemicals in the environment varies due to differences in water solubility, absorption rates into organic and inorganic matter, and sensitivity to photo decomposition or microbial activity. No-spray riparian buffers substantially reduce the risk of contamination (Norris et al. 1991), but toxic levels of chemicals may still reach streams from runoff and wind drift (Schulz 2004). If contamination of surface waters occurs and results in sufficiently high concentrations of a chemical, impacts to salmonids and designated critical habitat can occur, including acute and chronic toxicity, leading to injury or death, behavior modifications, reduced growth, decreased reproductive success, and increased vulnerability to diseases and pathogens (reviewed in Beschta et al. 1995). Norris et al. (1991) reviewed the behavior and toxicity of many of the commonly used herbicides, but newer chemicals are not discussed. Although there is substantial literature on the toxicity of various herbicides on salmonids, most of the information comes from laboratory studies focusing on acute lethal doses and not on chronic toxicity (Spence et al. 1996).

On January 22, 2004, the district court for the Western District of Washington in Seattle issued an injunction against the Environmental Protection Agency (EPA) and vacated EPA's authorization of most agricultural uses of 54 active ingredients within 20 yards (and aerial application within 100 yards) of salmon streams in California, Oregon, Idaho, and Washington (Washington Toxics Coalition v. Environmental Protection Agency, Case No. C01-0132C). Those active ingredients which require buffers are indicated in Table 14. There are further modifications imposing stricter requirements for certain specific pesticides and excluding certain other practices from the injunction. The injunction lasts until EPA has completed its consultation obligation, which is currently underway.

In this assessment, NMFS also expects that FGS will comply with the ground and aerial buffers established in the Washington ruling. The application of chemicals by FGS or its representatives is subject to the requirements of all applicable federal and state laws, including the recent court decision cited above, as well as the prohibitions against take of listed species pursuant to section 9 of the ESA.

**Table 14. Forest chemicals and methods of application currently used by FGS as part of its forest management activities.**

| **Active Ingredient** | **Chemical Trade Name** | **Application Type** | **Buffer Required by USEPA** |
|---|---|---|---|
| Hexazinone | Velpar-L, Velpar-DF, Pronone | Pre- or Post-emergent; applied by hand and aerially. Used to control undesirable grasses, forbs, and broadleaf species. | NA |
| Glyphosate | many formulations | Post-emergent; applied by hand and roadside. Used to control undesirable grasses and broadleaf species. | No |
| Imazapyr | Arsenal AC, Chopper | Post-emergent; applied by hand. Used to prepare clearcut sites for reforestation, to release conifers from competing vegetation, and to provide control of many annual and perennial weeds. | No |
| Triclopyr BEE | Garlon 4, Garlon 3A | Post-emergent; applied by hand, aerially, and roadside. Used to control broadleaf weeds and brush. | Yes |
| Atrazine | Aatrex Nine-O | Pre-emergent; applied by hand. | No |
| Clopyralid | Transline | Post-emergent; applied by hand, aerially, and roadside. Used to control broadleaf weeds such as thistle. | NA |
| 2,4-D | many formulations | Post-emergent; applied by hand, aerially, and roadside. Used to control many types of broadleaf vegetation, especially woody species such as willow, alder, sumac, and sagebrush. | Yes |
| Sulfometuron-methyl | Oust | Pre-emergent; applied by hand. Used for nonselective weed control. Applied to soils at extremely low rates. | No |
| **Adjuvants and other compounds** | | | |
| Methylated Seed Oil | MOC, Kinetic | Foliar applications | No |
| Oil surfactant | Herbimax | Foliar applications | No |
| Dimethylpolysiloxane | Fighter F | Foliar applications | No |
| Nonionic Surfactant | Induce | Foliar applications | No |
| Aklyl Polyoxyethylene ether, fatty acids | Activator 90 | Foliar applications | No |
| Petroleum Oil | Brush and Basal Oil, Agridex | Foliar applications, Basal Applications | No |
| Silocone +MSO Blend | Dyne-Amic | Foliar applications | No |
| Permethrin (pheromone/insecticide) | Last Call | Foliar applications | |
| Spray Dyes | Color-fast purple | Foliar applications | No |

*Hexazinone*

Hexazinone is typically used to control competing plant growth in newly planted areas. Hexazinone is very mobile in the soil and is readily transported in the first storms of the winter period (Norris et al. 1991). Where forestry applications have been monitored, concentrations in a nearby perennial stream peaked at 0.023 mg/L with the initial storm pulse and subsequent pulses were 0.01 mg/L or less (Neary et al. 1983 *op. cit.* Norris et al. 1991). The compound breaks down rapidly in water exposed to sunlight. Hexazinone is essentially non-toxic to invertebrates in the amounts commonly applied during forestry activities (EPA 1982 *op. cit.* Norris et al. 1991) with LC50s for invertebrates and microorganisms above 10mg/L – well above the amounts noted above in streams. For fish, the LC50 is greater than 100mg/L in various studies (USFS 1984 *op. cit.* Norris et al. 1991). Hexazinone is rapidly eliminated from animal tissue once exposure ceases; it does not tend to bio-accumulate. Studies of fish exposed to high concentrations of the compound cleared themselves of residues after two weeks in clean water (Rhodes 1980 *op. cit.* Norris et al. 1991). Given the concentrations needed to produce effects in aquatic organisms, coupled with the application rates, and concentrations observed in field studies, we don't expect that aquatic biota will experience any changes in growth rates, reproductive success or mortality rates as a result of applying this compound.

*Glyphosate*

Glyphosate is the active ingredient in "Honcho" and "Mirage" and is used to control grasses and other undesirable plant species. Glyphosate is very immobile in the soil and rapidly rendered inactive over a period of several weeks (Norris et al. 1991). Where agricultural applications have been monitored, concentrations in runoff ranged up to 5.2 mg/L when runoff occurred the day after heavy application (8.96 kg/hectare) but for lower application rates, concentrations up to 0.094 mg/L were observed (Norris et al. 1991). In forested applications with no buffer strips and the streams receiving direct aerial application of the herbicide, the concentration of glyphosate reached 0.5 mg/L (Norris et al. 1991). Studies indicate median lethal concentrations for rainbow trout occurring as low as 2 mg/L, but effects are very dependent on pH. Glyphosate is considered relatively non-toxic to fish and one of the forest herbicides least likely to have sublethal effects (NMFS 2003). The potential for the compound to build up in the tissues of aquatic organisms is very low (Extoxnet 1996). Since glyphosate is applied by hand and roadside, and is very immobile in the soil, we do not expect instream concentrations to approach those seen in studies referenced above. Thus, we expect that the salmonids will rarely be exposed to the substance. Therefore, we do not expect any salmonid mortality or changes in growth rates or reproductive success.

*Imazapyr*

Imazapyr is the active ingredient in "Arsenal" and "Chopper," used by FGS to prepare clearcut sites for reforestation and control competing vegetation around young conifers. A substantial amount of testing of imazapyr products has been conducted to evaluate its potential toxicity to non-target organisms. In the State of Washington, imazapyr was undetectable in the initial tidal exchange waters following the direct application of the compound to estuarine sediments [Washington State Department of Agriculture (WSDA) 2003]. Imazapyr is considered practically non-toxic to fish based on standard 96-hour exposure studies (WSDA 2003). Bioaccumulation of imazapyr in aquatic invertebrates is low, therefore, the potential for exposure through ingestion of organisms accumulating imazapyr is also low (WSDA 2003). Tests for sub-lethal effects revealed no effects on hatching or survival in rainbow trout with concentrations up to 92 and 118 mg/L (WSDA 2003). Based on this information, we do not expect any mortality or changes in reproductive success of salmonids from FGS's use of this herbicide.

*Triclopyr BEE*

Triclopyr BEE is the active ingredient in "Garlon 4," used by FGS for control of competing vegetation in recently clearcut areas. In general, a "buffer zone" of 20 yards is required when making ground-based applications, and 100 yards when applying the compound aerially. Garlon 4 is highly toxic to rainbow trout, with median lethal concentrations (LC50) occurring at 0.74mg/L (Dow Chemical Company 1983 *op. cit.* Norris et al. 1991, Dow Chemical Company 2009). Triclopyr dissipates relatively rapidly in the soil through microbial activity and photo decomposition, reducing the likelihood of exposure to aquatic organisms. In soils of increasing organic matter such as would be found on FGS's timberlands, this dissipation appears to occur much more rapidly (Norris et al. 1991). McKellar et al. (1982 *op. cit.* Norris et al. 1991) found that water concentrations of triclopyr following heavy treatment in small, forested watersheds (11.2 kg/hectare) ranged from non-detectable to 0.02 mg/L. Lee et al. (1986 *op. cit.* Norris et al. 1991) concluded that there is little likelihood that triclopyr will leach from adjacent forest applications into water. Therefore, given the buffers required for application, and the low mobility of Garlon 4, we expect a low likelihood of salmonid exposure to Triclopyr BEE. We reason that the uncertainties associated with complete adequacies of required buffer strips and aerial application measures (Schulz 2004), combined with the length of the ITP term (50 years), may result in one or more instances of exposure over the life of the ITP. However, in the event of exposure, we do not expect the concentrations of the compound will occur in sufficient quantities to cause a detectable response in salmonids based on the studies cited above.

*Atrazine*

Atrazine is the active ingredient in "Aatrex" and is used by FGS for the selective control of broadleaf and grassy weeds. Tests indicate that most of the atrazine disappears from the soil within one year of application. However, while in the soil, atrazine is highly mobile and may be delivered to watercourses during rainfall events and potentially affect aquatic biota. Studies on agricultural croplands indicate that runoff from adjacent fields may generate concentrations in receiving streams up to 0.032 mg/L (Frank and Sirons 1979, *op cit.* Norris et al. 1991). No residues were detected in receiving waters when a 9-foot unsprayed buffer strip was left adjacent to the watercourse (Douglass et al. 1969, *op cit.* Norris et al. 1991). Given that FGS applies atrazine by hand, we do not expect instream concentrations will exceed those seen for the above cited agricultural plots where the substance was more broadly applied.

Aquatic invertebrates, which provide a food source for salmonids, are also sensitive to atrazine. Concentrations of 0.23 mg/L of atrazine resulted in reduced hatching success, larval mortality, developmental abnormalities and a reduction in the number of emerging adult chironomids (Macek et al. 1976, *op cit.* Norris et al. 1991). Although chironomids are typically not a principal source of invertebrate prey for salmonids, the data indicate the magnitude in which effects to aquatic invertebrates could be expected. A limitation with using chironomids is that they may be a more tolerant species than mayflies and caddisflies, which are a principal food source for juvenile salmonids. However, given the concentrations observed in the above field studies compared to the sensitivity of chironomids to atrazine in the water column, we do not expect that any mortality or developmental changes in aquatic invertebrates will appreciably alter the prey base available to juvenile salmonids.

Laboratory and field tests show that atrazine is toxic to fish when present in sufficient concentrations. Concentrations of 0.24 mg/L produced significant reductions in the survival and growth of brook trout fry (Macek et al. 1976 *op. cit.* Norris et al. 1991). Analysis of muscle tissue from brook trout indicated that these fish did not bioconcentrate detectable amounts of atrazine after prolonged exposure (Macek et al. 1976 *op. cit.* Norris et al. 1991). We reason that the low concentrations expected in streams combined with the levels required to induce effects in salmonids will not result in detectable changes in salmonid growth, reproduction or survival rates. Although the above information is for juvenile fish, we do not have information concerning the effects on other life history stages. We expect that adults are least likely to be affected given that when they are present in smaller streams most likely to contain detectable amounts of atrazine, stream flows are much higher, and any sources of atrazine are diluted by the flows as well as likely less toxic to adults due to body size. Although we do not have information on the susceptibility of developing salmonid eggs to atrazine exposure, we expect that levels which would affect the development of aquatic invertebrates would be sufficient to cause a change in egg-to-fry development. In this case, we note that the earliest developmental stage of gammarids (amphipods) was reduced when exposed to concentrations of atrazine of 0.14 mg/L (Macek et al. 1976 *op. cit.* Norris et al. 1991). This suggests that the smallest developing organisms will not experience detectable effects by the presence of atrazine given the expected concentrations of the substance in the water column. In summary, we do not expect that the application methods and expected concentrations of atrazine will result in detectable effects on salmonids in the action area.

*Clopyralid*

Much of the following information is derived from the Draft Marin Municipal Water District Vegetation Management Plan Herbicide Risk Assessment (MMWD 2008). "Transline" contains the active ingredient clopyralid MEA and other inert ingredients isopropyl alcohol and the polyglycol surfactant, as well as other proprietary ingredients. There are three forms of clopyralid currently registered for use in the US; the parent carboxylic acid, the triethylamine (TEA) salt and the monoethanolamine (MEA) salt. The acid form was first registered for use in 1987 and the TEA and MEA salts in 1989. In 2005 the State of California reported 12,100 pounds of clopyralid and its salts were used. Clopyralid is a pyridinecarboxylic acid herbicide often used in the control of thistles and clover. Similar to triclopyr, clopyralid acts as a synthetic auxin, or growth hormone, altering plant growth that interferes with nutrient transport and can inhibit cell growth and division.

Most published toxicity studies were conducted with either clopyralid acid or clopyralid MEA. Clopyralid toxicity to fish ranges from not acutely toxic to slightly acutely toxic but the lack of significant data contributes to the high uncertainty associated with this assessment. The USFS toxicity reference value (TRV) for acute clopyralid exposure to a sensitive species uses an LC50 for rainbow trout of 104 mg/L. This value is for the more toxic clopyralid acid, and not clopyralid MEA. A study published in 2009 found that zebrafish embryos exposed to the highest concentration of clopyralid (10 mg/L) showed a significantly reduced touch response, but concluded that this response may not represent a biologically meaningful effect (Stehr et al. 2009). These researchers concluded that this herbicide is not likely to be toxic to embryos of listed salmonids and steelhead (Stehr et al. 2009). No long-term studies are available on the toxicity of clopyralid to fish eggs or fry. Limited other studies found that clopyralid is not acutely toxic to invertebrates (MMWD 2008). Given the restrictions on the use of clopyralid, the findings of low or no toxicity to aquatic organisms at concentrations much higher than would be expected in the action area, and the low exposure potential to listed salmonids from the application of chlorpyralid on FGS lands, we do not expect that the application methods and expected concentrations of chlorpyralid will result in detectable effects on salmonids in the action area.

*2,4-D*

2,4-D is the active ingredient in "Riverdale LV6" and is used to control competing woody vegetation. This is a widely used herbicide, applied to control vegetation for several purposes. In soil, 2,4-D persists for a very short time, rapidly disappearing due to plant uptake and microbial decomposition. Further, soil organic matter readily adsorbs 2,4-D, which tends to limit its mobility. Norris (1981 *op. cit.* Norris et al. 1991) concluded that direct application and drift to surface waters are the processes most likely to produce the highest residue levels, but that persistence is brief, usually less than 48-hours. In comparing expected concentrations resulting from field application to lethal thresholds, NMFS (2003) concluded that no impacts to any aquatic species is likely to occur from the general use of 2,4-D in a watershed. Physiological and morphological alterations have been seen in fish exposed to 2,4-D. Common changes seen in physiological parameters are changes in enzyme activity levels (Nešković et al. 1994). Exposure to 2,4-D has also been shown to cause morphological changes in gill epithelium in carp. These changes include lifting of the gill epithelium and clubbing of gill filaments, but are considered non-lethal if the exposed fish is removed to clean water for recovery (Nešković et al. 1994). In field conditions, this would be equivalent to swimming to an untreated area or the herbicide concentration decreasing to negligible levels. Carpenter and Eaton (1983) investigated the metabolism of 2,4-D in rainbow trout after injection, and found that almost 99 percent of the compound is excreted in the urine as unchanged 2,4-D, with a half-life of only 2.4 hours. The aerial application buffers required (see Table 15) will minimize any drift, particularly where herbicide is applied on recently harvested areas and the application is from a low altitude. However, given the uncertainties surrounding the effectiveness of no-spray buffers and aerial drift, there is still the likelihood that some of the compound may enter a nearby watercourse over the life of the ITP. However, given the short persistence time in water should drift occur, we do not expect any mortality or reduced reproductive success or growth rates from the use of 2,4-D.

*Sulfometuron-methyl*

Sulfometuron-methyl is the active ingredient in "Oust" and is used by FGS in the control of competing vegetation. Sulfometuron-methyl is used for conifer site preparation and general weed control along roadsides. The following information is summarized from the California Department of Pesticide Regulation's (CDPR undated) document summarizing the environmental fate of Sulfometuron-methyl. Sulfometuron-methyl is slightly toxic to fish and aquatic invertebrates. Its LC50 in adult rainbow trout is greater than 12.5 mg/L. Toxicity to rainbow trout occurs at 13 parts per million (ppm). Levels of sulfometuron-methyl in bluegill sunfish were well below the level for toxicity after exposure to the compound for 28 days and, therefore, is not thought to bioaccumulate. Because it does not bioaccumulate, the compound is only slightly toxic to freshwater fish. Sulfometuron-methyl is practically nontoxic to the water flea (*Daphnia magna*), suggesting that aquatic invertebrates, and thereby the prey base of salmonids, are not affected by low levels of the compound in streams. Little specific information is available on the potential sublethal effects of the compound (NMFS 2003), although the water flea is often regarded as a sensitive indicator to toxic substances (CDPR undated). Since sulfometuron-methyl shows little tendency to bioaccumulate and does not have long-term persistence in food chains, we do not expect any chronic effects to occur (NMFS 2003). Given the hand application of this compound and the relatively low rates of application by FGS, we expect salmonid exposure to the compound to be very low, if any, and, consequently, we do not expect any mortality or reduced reproductive success or growth rates in salmonids.

*Adjuvants and other compounds*

The various adjuvants listed in Table 15 used by FGS are surfactants used to improve the emulsifying, dispersing, spreading, wetting, or other surface modifying properties of liquids. Surfactants are frequently toxic. The surfactant R-11 has a 96-hour LC50 of 3.8 ppm for rainbow trout, making it considerably more toxic to fish than the glyphosate it is commonly mixed with (Diamond and Durkin 1997) Curran et al. (2004) found that R-11 was significantly more toxic to smaller rainbow trout (0.39 g) than it was to larger fish (15.46 g) when the LC50 of each size was compared (5.19 ppm v. 6.57 ppm) and that U.S. Environmental Protection Agency (EPA) test criterion size (<3 g) indicates that differences in fish size may cause differences in the 96-hour LC50 as great as 200 percent. Furthermore, the surfactant R-11 has been implicated as causing endocrine disruption in fish and amphibians as one of its constituents is a nonylphenol polyethoxylate (NPE). Nonylphenols are weakly estrogenic, and have been shown to cause endocrine disruption under laboratory conditions at low doses (20 ppb, UK Marine SACS Project 2003). In comparison to the herbicides used during vegetation treatments, the surfactant R-11 is more toxic and has a range of effects that present themselves in the low parts per billion concentration range. Unfortunately, little information could be located on the potential toxicity of the other adjuvants listed in Table 14. For methylated seed oils, a LC50 value of 53.1 mg/L was reported (NMFS 2003), suggesting that mortality is unlikely given the relatively high water concentration needed and provisions for avoiding streams. Preliminary laboratory results indicate that R-11 is likely the most toxic of the adjuvants used (Cabarrus et al. 2002).

There is some risk of surfactant drift during aerial applications that the riparian spray buffer requirements will reduce. Also, the proposed action will retain forested buffers along Class I and II streams, and areas within the buffer will not be aerially treated. Given these limitations, we expect that aerial drift will enter flowing watercourses only in rare instances. However, given the small concentrations of R-11 needed to cause the effects noted above, the aerial application of adjuvants may ultimately increase the likelihood of reproductive disruptions, reduced growth rates or even mortality of salmon and steelhead. Sublethal effects are characterized as those that occur at concentrations that are below those that lead directly to death. Sublethal effects may impact the fish's behavior, biochemical and/or physiological functions, and create histological alterations of the fish's anatomy. In addition, changes in the sensitivities of fish to other contaminants (i.e., chemical synergism) may increase the likelihood of mortality of exposed fish. For example, the toxicity of R-11 may increase when mixed with an herbicide (WSDA 2003). Thus, the additive and synergistic effects of chemical mixtures may result in greater than expected toxicity (Lydy et al. 2004). In considering the effects of R-11 on salmonids, we note two critical areas of uncertainty: (1) the extent of toxicity of R-11 to salmonids and their prey base, and (2) the uncertainties surrounding the effectiveness of no-spray buffers and aerial application measures discussed by Schulz (2004). While the application measures reduce the chance of exposure, over the 50-year term of the ITP, the likelihood exists that exposure may occur. We consider this a low likelihood given that the application site must be near a watercourse with salmonids present. We also presume that FGS will comply with any R-11 use restrictions that are imposed from future assessments of the impacts of this compound on listed species.

Given that toxicology data are largely unavailable for the other adjuvants, the effects on salmonids are unknown except for soy oil discussed below. Soybean oil is mixed with herbicides and used by FGS as an adjuvant. Adjuvants can affect herbicide performance in many ways including the spread of spray droplets on the leaf surface, retention of spray on the leaf, and penetration of the herbicide through the plant cuticle. The base oil is considered non-toxic to aquatic organisms, but formulated products may have additive effects that are toxic. The LC50 for rainbow trout in laboratory tests was 633 parts per million, but bubbling air through the test containers virtually eliminated the toxicity (Cheng et al. 1991). Although we do not have information on the concentrations that may be found in watercourses following soy-oil based applications, we expect the combination of buffer strips and application at the base of vegetation will minimize the delivery of soy oil to watercourses. We do not expect any toxic effects in salmonids given the high concentrations needed and the effects of turbulence (similar to bubbling air described above) in reducing toxicity.

*Permethrin*

Most of this information is derived from National Pesticide Information Center (NPIC 2009). Permethrin is an insecticide in the pyrethroid chemical family. It was registered for use by the United States Environmental Protection Agency (U.S. EPA) in 1979, and re-registered in 2006. It is used to control beetle infection and when used on large areas like crops, nurseries, and sod farms it is considered a restricted use pesticide. For other applications, it is considered a general use pesticide and is used for the treatment of head lice and scabies in humans. Permethrin acts on the nervous system of insects causing spasm, culminating in paralysis and death. Permethrin is highly toxic in the aquatic environment and when it enters an aquatic system, some is degraded by sunlight while in the water column, but much of it will bind tightly to sediment with a half-life in sediment that can last more than a year. Half-life in the water column may be 19-27 hours. It is considered highly toxic to marine/estuarine, freshwater fish and other aquatic organisms. Studies linked to potential toxicity to salmonids found a 96-hour LC50 of 2.5 μg/L for rainbow trout. A 48-hour LC50 for the insect *Daphnia* was found to be 0.6 μg/L. Permethrin in aquatic sediments may inhibit growth of exposed invertebrates at levels as low as 44-73 ng/g sediment. In a California sediment toxicity study, researchers found detectable levels of permethrin in 26 of 30 creek sediment samples. All 30 samples were found to be toxic to *Hyalella azteca*, a local species of amphipod, at 15 °C; however, several sediment samples also included other pyrethroids and low levels of organophosphates and/or organochlorines.

Within the action area, FGS uses permethrin to control damaging insects. FGS last used a permethrin product to control Western pine shoot borer (*Eucosma sonomana*) in 2007 and 2008 in a pine plantation in the Grass Lake Management Unit.; the borer can impact log quality. FGS aerially applied the product to 400 acres in 2007 and 130 in 2008. Application rate was approximately one ounce per acre. FGS does not apply the product within any WLPZ, nor when rain and snow is predicted in the immediate forecast. The EPA establishes a 25-foot aquatic buffer zone for ground applications of permethrin and a 100-foot buffer for aerial applications. When FGS applies the product the formulation sticks to the top of trees.

We anticipate that use of the product, even with the protective measures in place, will result in some incidences of toxicity in nearby receiving waters as the product has a half-life of 19-27 hours, meaning there is still some level of toxicity remaining after this period. We expect that rain events could occur 48-hours after the application, as predictions can be somewhat inaccurate and precipitation could be of sufficient quantity and duration to cause runoff in areas where the application occurred. Also, we expect there could be some "drift" that occurs during aerial applications as winds can also be unpredictable at times, even with precautions in place. Occurrences of drift could cause the product to enter the WLPZ and contaminate watercourses in isolated areas. Because the product has such low toxicity thresholds we anticipate that over the duration of the permit there may be isolated incidences where localized toxicity of the aquatic systems occurs exposing covered species to acute levels of permethrin that may result in the death of a few individuals. Depending on timing of application death could occur to adults if applied in the early fall, or juveniles, if applied in the spring and summer months.

*Summary*

Our review of the application methods, transport and fate of the various herbicides and one insecticide indicates that the chance of these chemicals entering a fish-bearing watercourse is relatively low, but not impossible over a 50-year time period. Further, toxicology data indicate that for most chemical compounds, with the exception of permethrin, the exposure levels to be expected under forest application would not be sufficient to cause adverse effects to salmonids. However, we note that mixtures of the various compounds may be having greater effects on salmonids and their habitat than that considered for the compounds individually (Lydy et al. 2004). For instance, we are concerned with the aerial application of these chemicals and the adjuvants used. Despite the lack of information on the toxicology of these adjuvants, and the uncertainties surrounding mixtures of these compounds, existing information for the surfactant R-11 indicates that aerial application of these substances may cause sublethal effects with consequent mortality of salmonids where streamside buffers are narrow and aerial drift occurs. While we expect that the risk to salmonids is exceedingly low in any given year, when considered over the 50-year term of the ITP, isolated incidences of aerial drift and exposure may occur. Furthermore, given the low concentrations of compound needed to induce a sub-lethal response, the likelihood exists, where aerial applications occur adjacent to fish-bearing streams, that individual salmonids may experience reductions in growth rates or other sub-lethal effects as a result of effects arising from the presence of adjuvants in streams. As previously mentioned, we consider this a low likelihood of occurring given that the application site must be near a watercourse with salmonids present, and we presume that FGS will comply with any R-11 use restrictions that are imposed from future assessments of the impacts of this compound on listed species. Chemical application is under the jurisdiction of several federal, state, and local agencies and their use is expected to be conducted under applicable laws.

# 7 CUMULATIVE EFFECTS

NMFS must consider both the effects of the proposed action and the cumulative effects of other activities in determining whether the action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. Under the ESA, cumulative effects are those effects of future state, tribal, local, or private actions (excluding the effects of the proposed action) that are reasonably certain to occur in the action area which lies beyond the FGS HCP plan area. Figure 9 shows a graphical representation of effects from the proposed action as well as other cumulative effects that interplay into the conservation potential for the three covered species. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

NMFS believes that listed species and their critical habitat may be affected by numerous actions by State, tribal, local, or private entities that are reasonably certain to occur in the action area. These actions include, but may not be limited to, those discussed below. Although each of the following actions may reasonably be expected to occur, we lack definitive information on the extent or location of many of these categories of actions, particularly since this is a 50-year assessment. The following discussion provides available information on the expected effects of these activities on salmonids.

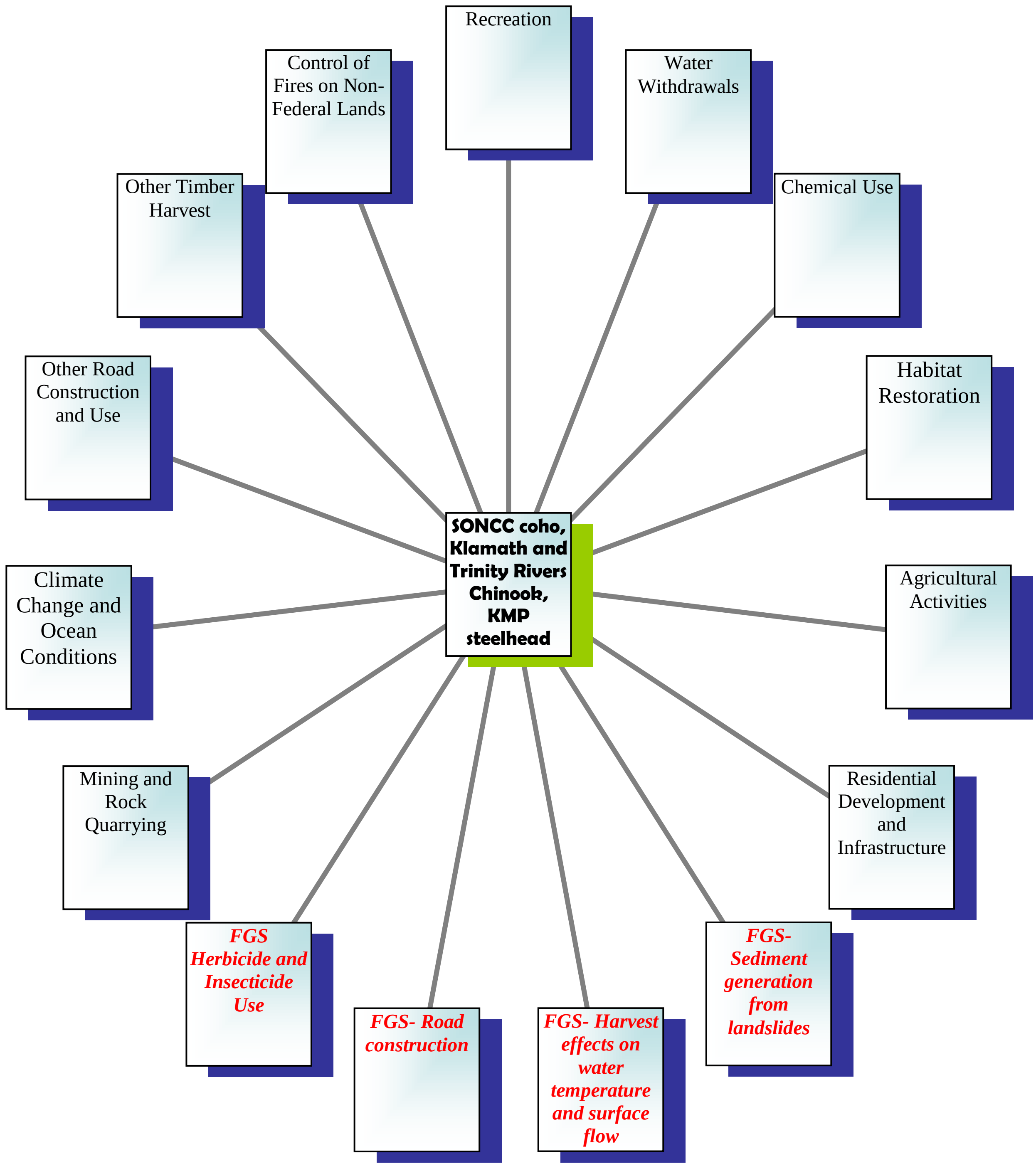


**Figure 9. FGS Proposed Action in relation to Cumulative Effects and Stressors in the Action Area**

## 7.1 Timber Management on Other Private Lands

Timber management, with associated activities such as harvest, yarding, loading, hauling, site preparation, planting, vegetation management, and thinning, occurs in the action area. Future private timber harvest levels in the action area cannot be precisely predicted, however, we assume that harvest levels on private lands in Siskiyou County and within the action area in the foreseeable future will be within the approximate range of harvest levels that have occurred since the listing of the northern spotted owl in 1992.

Implementation of THPs under the CFPRs has not consistently provided protection against unauthorized take in relation to salmonids listed under the ESA by NMFS, such as listed SONCC coho salmon. It is NMFS' opinion that CFPRs have not in the past and continue to not provide for adequate salmonid habitat protection and recovery and are resulting in chronic impairments in shade, LWD, stream temperature, and sediment levels. NMFS has informed the California Board of Forestry (BOF) of its ongoing concern over the lack of specific provisions for Pacific salmonids in the CFPRs. Discussions continue on this issue between NMFS, BOF, and the California Resources Agency. Recent revisions to the CFPRs address some concerns related to salmonids, however, until all issues are resolved unauthorized take from direct, indirect, and cumulative effects of listed Pacific salmonids from timber harvest and its associated activities may be occurring and likely will continue to occur. The extent and amount of any unauthorized take is unknown.

Reasonably foreseeable effects of timber management activities may also impact designated critical habitat for SONCC coho salmon. There are fish-bearing streams on private land outside of the FGS ownership but within the action area. Within the action area, direct, indirect, and cumulative effects of timber harvesting on lands outside of the FGS ownership may degrade the habitat features identified as essential for the conservation of coho salmon. These effects are expected to be more adverse, as they are conducted under CFPRs, than the effects of the covered activities on the FGS ownership with implementation of the HCP.

### 7.1.1 Control of Wildland Fires on Non-Federal Lands

Control of wildland fires may include the removal or modification of vegetation due to the construction of firebreaks or setting of backfires to control the spread of fire. Also, the use of fire retardants may adversely affect salmonid habitat. An undetermined amount of suitable habitat for Pacific salmonids may be removed or modified by these activities.

### 7.1.2 Construction, Reconstruction, Maintenance, and Use of Roads

While the level of construction of new roads and reconstruction of old roads on private and state lands cannot be anticipated, we expect construction to continue at a pace similar to the current pace as an average over the life of the permit as the plan area currently has a well-developed road network in place and FGS does not anticipate the need to build a significant amount of new roads. Exceptions might occur if FGS decides to decommission old roads that either are difficult to maintain, or are determined to be environmentally damaging and a better alternate road route can be built providing access to timber stands . With this, the increased emphasis on protection of aquatic resources is expected to result in higher standards for road construction, reconstruction, maintenance, and use as compared to historical standards. Improvement of environmental conditions on private and state lands related to roads throughout the action area is expected over the long-term due to an increasing emphasis on watershed-scale inventory, assessment and treatment of road networks as regulatory sediment reduction requirements are implemented in the action area (e.g., TMDLs). However, funding for such efforts is limited and these roads are expected to continue to adversely affect salmonids and their habitat in the short term.

### 7.1.3 Mining, Rock Quarrying and Processing

Past mining activities in the action area were discussed in the *Environmental Baseline* section. NMFS anticipates that upland mining and quarrying will continue to be conducted by non-federal parties within the action area. The effects of mines and quarries on aquatic resources in the action area depend on the type of mining, the size of the quarry or mine, and distance from waters. Mining can cause increased sedimentation, accelerated erosion, increased streambank and streambed instability, and changes to substrate. Surface mining may result in soil compaction and loss of the vegetative cover and humic layer, thereby increasing surface runoff. Mining may also cause the loss of riparian vegetation. Chemicals used in mining can be toxic to aquatic species if transported to waters. Because the effects of mines and quarries depend on several variables, the effects of mines and quarries and other commercial rock operations within the action area on Pacific salmonids are unknown. Commercial rock quarrying will continue to be under the regulation of Siskiyou County.

### 7.1.4 Habitat Restoration Projects

NMFS anticipates that, as monitoring information accumulates on past projects, the focus of stream restoration projects will gradually shift toward more effective restoration actions. Because such activities are usually coordinated with one or more of the resource agencies, we anticipate that all applicable laws will be followed. Restoration activities conducted through CDFG's Fisheries Habitat Restoration Program are covered by a Section 7 consultation with the U.S. Army Corps of Engineers, and are therefore not considered a cumulative effect. Restoration activities that are not conducted pursuant to CDFGs program may cause temporary increases in turbidity, alter channel dynamics and stability, and injure or scare salmonids if equipment is used in the stream. Properly constructed stream restoration projects may increase habitat complexity, stabilize channels and streambanks, increase spawning gravels, decrease sedimentation, and increase shade and cover for salmonids. These projects often focus on identifying source problems in an area (i.e., roads) and apply corrective measures to eliminate or minimize the adverse effects to aquatic resources.

We do not know how many restoration projects will be completed outside of CDFG's program; therefore, the effects of these projects cannot be predicted. However, we anticipate many of these projects may still require a Corps permit, and, thus, require consultation.

### 7.1.5 Agricultural Activities

Agricultural activities in the action area include grazing, dairy farming, and the cultivation of crops. Many of the past impacts of these activities were previously discussed in the *Environmental Baseline* section. Impacts on water quality would be expected to be regulated under applicable laws.

The impacts of this use on aquatic species is anticipated to be locally intense, but the longevity of the impact depends on the degree of grazing pressure on riparian vegetation, both from dairy and beef cattle. Grasses, willows, and other woody species can recover quickly once grazing pressure is reduced or eliminated (Platts 1991) through fencing, seasonal rotations, and other measures. Assuming that appropriate measures are not taken to improve practices over time, reduce grazing pressure, impacts to aquatic species are expected to remain static. Grazing impacts include decreased bank stability, loss of shade- and cover-providing riparian vegetation, increased sediment inputs, and elevated nutrient levels.

### 7.1.6 Residential Development and Existing Residential Infrastructure

Human population growth in Siskiyou County is expected to continue. Most of this growth is expected to occur in the valley bottom settings near Yreka and in the Scott and Shasta Valleys. Impacts on water quality related to residential infrastructure would be expected to be regulated under applicable state and local laws.

Once development and associated infrastructure (e.g., roads, drainage, water development) are established, the impacts to aquatic species are expected to be permanent. Anticipated impacts to aquatic resources include loss of riparian vegetation, changes to channel morphology and dynamics, altered hydrologic regimes (increased storm runoff), increased sediment loading, and elevated water temperatures where shade-providing canopy is removed. The presence of structures and/or roads near waters may lead to the removal of LWD in order to protect those structures from flood impacts. The anticipated impacts to Pacific salmonids from continued residential development are expected to be sustained and locally intense. Commonly, there are also effects of home pesticide use and roadway runoff of automobile pollutants, introductions of invasive species to nearby streams and ponds, attraction of salmonid predators due to human occupation (e.g., raccoons), increased incidences of poaching, and loss of riparian habitat due to land clearing activities. All of these factors associated with residential development can have negative impacts on salmon populations.

### 7.1.7 Recreation, Including Hiking, Camping, Fishing, and Hunting

Expected recreation impacts to salmonids include increased turbidity, impacts to water quality, barriers to movement, and changes to habitat structures. Streambanks, riparian vegetation, and spawning redds can be disturbed wherever human use is concentrated. Campgrounds can impair water quality by elevating nutrients in streams. Construction of summer dams to create swimming holes causes turbidity, destroys and degrades habitat, and blocks migration of juveniles between summer habitats. Impacts to salmonid habitat are expected to be localized, mild to moderate, and temporary. Fishing within the action area, typically for steelhead or Chinook salmon, is expected to continue subject to CDFG regulations. The level of impact to salmonids within the action area from angling is unknown, but is expected to remain at current levels.

### 7.1.8 Water Withdrawals

An unknown number of permanent and temporary water withdrawal facilities exist within the action area. The nature of their impacts was discussed in the environmental baseline section. These include diversions for urban, agricultural, commercial, and residential use, along with temporary diversions, such as drafting for dust abatement. Approximately 81,070 acre feet of water is diverted from the Scott River annually (Van Kirk and Naman 2008). Numerous other water diversions in the systems that feed the Klamath River decrease the quantity of mainstem flows on the Klamath River mostly during the summer months, when juvenile access to cooler tributaries and cooler mainstem water temperatures is essential.

In the fall of 2009, the CDFG released a Final Environmental Impact Report (FEIR) on the Scott River Watershed-Wide Permitting Program (WWPP) which accompanied a process by which agricultural operators in the Scott River watershed could receive incidental take coverage for coho salmon under state law if the operator diverts water from a stream by means of an active diversion for an agricultural purpose, or is involved in an agricultural operation on property in the WWPP area through which or adjacent to which a stream flows. Recently, the EIR for the program was challenged in court, and was ruled to be insufficient. We are unsure whether the WWPP will be reinstated, and if so, within what timeframe. An active diversion is defined as a surface water diversion that has operated at least one out of the last five years. The WWPP also implements certain stream restoration projects in the Scott River watershed identified in the California Fish and Game Commission's (Commission) *Recovery Strategy for California Coho Salmon* (February 2004) as key coho recovery projects. Under the WWPP, the Siskiyou County Resource Conservation District (RCD) will be responsible for implementing those recovery projects. One of DFG's objectives for this program is to eliminate unauthorized take of coho salmon caused by water diversions in the Scott River watershed and avoid, minimize, and fully mitigate take of coho salmon incidental to diverting water with a valid water right, recovery actions, and other lawful activities.

Under the WWPP, CDFG will issue the RCD and agricultural operators individual state streambed alteration agreements for purposes of complying with Fish and Game Code, § 1600 *et seq*. As a condition of participating in the WWPP, the RCD and agricultural operators must also obtain separate authorization from CDFG to authorize any take of coho salmon that could occur incidental to a covered activity within the WWPP for purposes of complying with the California Endangered Species Act (CESA). Among other general ITP conditions, improvements to water management and water rights, fish screen improvements, targeted priority fish passage improvements, and stream crossing improvements are all a part of the program designed to both provide take coverage for landowners as well as implement a longer-term strategy to improve habitat conditions for coho in the Scott River. The term of the WWPP is 10 years from date of issuance.

We do not expect the number or quantity of diversions to increase in the action area given the already high levels of water withdrawals and the issues surrounding limited water resources as the present time. Given the complexities of the WWPP it is possible more landowners will transition from instream diversion for their water needs, to off channel wells and pumps. Although there would be a benefit to salmonids from ending instream pumping and diversions such as entrapment and impingement of younger salmonid life stages within pump systems, there is currently a poor understanding of how groundwater withdrawals could affect near stream surface flows. A greater reliance on groundwater withdrawals could lead to similar reductions in streamflows still resulting in localized dewatering of reaches, and depleted flows necessary for migration, spawning, rearing, flushing of sediment from the spawning gravels, gravel recruitment, and transport of LWD. We are currently unsure of the benefits the WWPP will provide to salmonids in the Scott River watershed, but expect they are likely to be minimal.

### 7.1.9 Chemical Use

NMFS anticipates that chemicals such as pesticides, herbicides, fertilizers, and fire retardants will continue to be used within the action area. Chemical application is under the jurisdiction of several federal, state, and local agencies and their use is expected to be conducted under applicable laws. The effects of these chemicals on salmonids are expected to be similar to the effects described in the *Effects of Herbicide and Pesticide Use* section of this Opinion.

### 7.1.10 Climate Change

The long term effects of climate change were discussed in the *Environmental Baseline* section. These include changes in streamflow regimes and water temperatures. In summary, climate change poses a high threat to the covered species within the action area. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate in the action area is generally warm, and modeled regional average temperatures shows a large temperature increase over the period of the permit; with average ambient temperatures increasing by as much as 3 $^{o}$C in the summer and by 1$^{o}$ C in the winter, while annual precipitation in this area is predicted to trend downward over the next century. Additionally it is predicted that snowpack in upper elevations of the Klamath basin will decrease with changes in response to changes in temperature and precipitation (California Natural Resources Agency 2009). Rearing and migratory habitat are most at risk to climate change. Increasing water temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Adults will also be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (ISAB 2007, Feely et al. 2008, Portner and Knust 2007). Overall, the range and degree of variability in ambient temperature and precipitation are likely to increase in all populations, creating long term threats to the persistence of coho salmon in this area. These predictions further highlight the importance of providing suitable refugia habitat in mainstem tributaries.

# 8 INTEGRATION AND SYNTHESIS

Our synthesis of the effects of the proposed action considers the current status of the species, the environmental baseline, cumulative effects and the anticipated effects of the proposed action on watershed processes, salmonid habitat, species viability, and distribution. These effects are then summarized for each covered species and for SONCC coho salmon designated critical habitat. Recall that in the introduction to the *Effects of the Action* section we listed seven critical questions for our jeopardy analysis. We then addressed the first two questions: the physical and biotic processes affected by the proposed action (question #1) and their likely responses (question #2). This section continues to address those initial questions and we note them in the text that follows.

## 8.1 Status and Baseline Summaries

The *Status of the Species* section described general life history and population trends for each ESU. The *Environmental Baseline* section provided additional information, where available, on species demographics and factors limiting their recovery across the action area. Each species is summarized below.

### 8.1.1 SONCC coho salmon

Of all the covered species, this ESU appears to be the most susceptible to continued population declines. Most data across the ESU and within individual watersheds show a steady decline in coho abundance. Recent data show that the number of streams where coho salmon are present continues to decrease, and in many of those stream systems still supporting coho, abundance and distribution are on a declining trend (see Figure 5).

### 8.1.2 KMP steelhead

KMP steelhead show mixed results in trends. As of 2000, many sub-populations showed modest upturns in abundance. However, in some cases populations are still declining. Although the ESU does not appear in danger of extinction, there is continued uncertainty with the overall viability of this ESU.

### 8.1.3 Upper Klamath-Trinity Chinook salmon

Several stocks in this population remain of concern while several Chinook salmon stocks are extinct. Remaining stocks of Upper Klamath and Trinity Rivers Chinook salmon appear to be relatively stable. High levels of hatchery production have increased the level of risk to naturally produced Chinook salmon.

## 8.2 Effects of Proposed Action on Salmonid Habitat

Our analysis of effects was organized around several watershed processes:

1. Hydrologic Regime
2. Habitat Access
3. LWD Recruitment Processes
4. Sediment Flux

5. Thermal Inputs and Stream Temperature Regimes
6. Nutrient and Contaminant Flux

Since these factors control the quality and distribution of freshwater habitat, we assumed that salmonid populations will respond to changes in the inputs of these watershed products because declines in the quality and distribution of freshwater habitat due to changes in these products appear to be the primary factor in the decline and current status of salmonids in the action area. Since salmonid populations appear to be strongly influenced by freshwater habitat in the action area, our determination of effects is focused on anticipated changes to stream habitat. Below, we integrate the changes in watershed processes and identify several mechanisms of habitat degradation that may occur as a result of the proposed action (question #3). The *Environmental Baseline* established that multiple life stages of all three species are present in the action area and a discussion of question #4 in the *Effects of the Action* section established that all life history stages of all three species will be exposed to the effects of the proposed action. Coupled with the habitat changes, we discuss effects on specific life history functions (i.e., salmonid spawning, emergence, juvenile rearing and out-migration) to better understand the life-stage specific responses to the proposed action that will be discussed in a subsequent section.

### 8.2.1 Effects on substrate characteristics

Timber harvest and related activities under the proposed HCP will continue to result in the generation and delivery of fine sediment to stream networks in the action area as high road densities and streamside roads occur throughout the action area. Timber harvesting and yarding activities and harvest-related landslides also will contribute to the quantity of sediment delivered to action area streams. FGS proposes several minimization measures that address roads, slope stability and harvest-related surface erosion. These measures are summarized in Section 2.4.1 *Aquatic Protection Measures* of this Opinion and detailed in the HCP, but include as highlights inventory and treatment of road erosion sources on a schedule that prioritizes high value coho watersheds, prioritization for the treatment of the few remaining road watercourse crossings that block fish passage within the plan area, careful scrutiny on harvest on unstable slopes, protection of trees that provide shade to pools that support coho, and protection of riparian stand characteristics that provide for the development of suitable salmonid long-term habitat needs. Collectively, these measures will decrease the rate of sediment that has been delivered to streams as compared to recent and historical management approaches.

In many areas, substrate characteristics are strongly influenced by high levels of fine sediment. We expect that quantities of fine sediment will generally decrease over the permit term, leading to generally improving conditions for salmonid spawning, juvenile cover and invertebrate habitat. However, we note that ongoing activities will likely result in pulses of fine sediment as roads are used and treated, and particular areas are subject to timber harvest. These effects will be ongoing and may slow the attainment of functional substrate conditions over the permit duration. Focusing the roads efforts in the highest priority watersheds will help ensure that periodic sediment inputs are reduced early on in the permit term and in the watersheds supporting the most sensitive sub-populations of covered species.

Salmonid spawning, emergence and juvenile rearing will gradually improve with these long term improvements in substrate conditions. However, interim pulses of sediment will result in adverse effects to these life history stages if this sediment enters watercourses that support covered species. Adverse effects, in summary, may be comprised of direct mortality via the smothering of redds and impairment of fry emergence, and indirect mortality via channel widening which can make streams shallow and warm, with a lack of adequate protective cover. These altered channels can result in reduced growth and survival rates due to increased competition of available space and food resources, and can result in increased rates of predation due to confinement of juveniles to limited pool space.

### 8.2.2 Effects on pool characteristics

We expect that quantities of pool-forming woody debris will gradually increase over the term of the permit as streamside stands attain functional sizes and are recruited to the channel. Similarly, failure of unstable hillslopes with retained trees will allow for inputs of large wood when these features fail and deliver to channels, although the measures for selective harvest on many of these areas and the occasions where geologic review underestimated the hazard will result in lower quantities of wood than if the area had not been harvested.

We expect that the HCP management activities will result in an increase in pool frequency and depth that will allow for increased production of salmonids over the long-term. However, this evolution of improving pool formation conditions may be tempered by the reduced quantities of wood delivered from harvested upslope areas and short-term pulses of sediment generated from harvest and road activities in specific areas. The most drastic change in pool development would be where harvest-induced landslides inundate a short reach with sediment and debris. We expect these instances to be rare and limited to relatively short stream reaches in the plan area with implementation of minimization measures of the HCP.

Large landslides delivering large quantities of sediment that would effect a significant portion of a salmonid stream are typically rare events in the action area; we anticipate that implementation of the HCP will help to minimize these rare occurrences even further given the review of unstable areas by a PG or CEG if harvest is proposed. Recovery of pool functions in these slide areas would occur in the ensuing years as the supplied debris provides necessary roughness elements for recreating pools, and as sediment moves through the system with high flows. In summary, we anticipate that the road improvement strategy, coupled with an anticipated reduction in the amount of clearcutting within the HCP area, will result in a gradual reduction in landslide frequencies across the action area throughout the 50-year permit term. The 15-year mass-wasting study will aid in this evaluation and will allow FGS and NMFS to adaptively manage the conservation strategy if this assumption is not demonstrated.

The riparian management strategy would help ensure development of riparian canopies and larger timber stands over the course of the permit term. We anticipate that with the development of more mature Class I and II riparian stands towards the end of the permit term we will observe increases in channel LWD that are stable and have the ability to contribute towards pool-forming processes. In addition, with limited harvest on unstable areas, we also anticipate that towards the end of the permit term, unstable areas are more likely to possess more mature conifer stands, that, should the unstable ground fail, are more likely to deliver wood that has the potential to provide pool-forming LWD. All life history stages for all covered species will accrue beneficial effects from changes in pool characteristics since these habitat types are used for multiple purposes (e.g., adult migration, juvenile rearing, spawning at pool tails and temporary holding for outmigrating smolts).

### 8.2.3 Effects on stream flows

While the hydrologic regime is likely different than what historically occurred prior to any management in these watersheds, we think the streamflow effects of the proposed operations under the HCP are small and not limiting populations of salmonids in the action area. The projected distribution and types of harvesting (i.e., even-aged versus selection harvest) that will occur across the action area, combined with CFPR adjacency requirements limiting the combined acreage of clearcutting across the landscape, largely precludes concentrated timber harvest over larger areas and, therefore reduces the chance that timber harvest patterns would have a measurable effect on peak flows within the affected basins.

### 8.2.4 Effects on stream temperature

We expect that the riparian buffers proposed along Class I and II watercourses in Class A lands will provide for generally adequate thermal protection of the adjacent stream. We are concerned, however, that the proposed 50-100' WLPZ along with a requirement for maintaining only 50 percent canopy cover in Class B Class II watercourses will become increasingly less effective as summer air temperatures increase with changing global climate in these affected watersheds. Over the long term, certain Class II watercourses could experience warming following harvest and these effects could translate downstream to fish-bearing reaches where individual juveniles have become increasingly reliant on cold water inputs from small streams. This effect would be most pronounced in areas where FGS has a large portion of the Class B watershed subject to harvest along Class II streams such as Moffett Creek.

### 8.2.5 Effects on habitat access

We expect any road-related barriers that are subject to the terms of the HCP to be upgraded to provide for passage of all life stages of salmonids. We do not expect that the proposed action will alter streamflow or channel conditions sufficiently to preclude passage to previously occupied stream reaches.

## 8.3 Life-stage Responses

This section addresses question #5 in our jeopardy analysis. Since the habitat requirements are sufficiently similar among the three salmonid species, we discuss the life-stage responses collectively.

### 8.3.1 Egg

Depending on the magnitude of the event, episodic pulses of sediment described above can impair egg survival-to-emergence rates. We do not believe these pulses will result in complete inundation of incubating eggs in an affected watershed in most instances, and we expect that the magnitude of these effects will diminish through time as substrate conditions improve with implementation of HCP conservation measures. Overall, we anticipate localized events that cause impairment of egg-to-emergence survival rates, but across the entire action area we anticipate improvement in these rates over the life of the permit period.

### 8.3.2 Fry

Periodic sediment pulses in response to timber harvesting activities may reduce the amount of substrate cover available for use as refuge habitat, but the extent of cover available will likely be sufficient for this particular use. Gradually improving substrate conditions via implementation of the HCP with an expected reduction in the rate and quantity of sediment delivery to fish-bearing watercourses, will lead to improved invertebrate production as a food source for fry as well as improvement (e.g., deeper and more frequent pools) in refugia habitat which can improve fry-to-smolt survival rates.

### 8.3.3 Juvenile

Streams in the action area are used by individual juveniles seeking refuge from inhospitable conditions downstream (i.e., poor water quality and/or hydrologic conditions in mainstem rivers) as well as the natally-reared juveniles already present. This is perhaps the most sensitive life stage that occurs in the action area as these individuals must survive both summer and winter periods.

In the action area, the summer period is characterized by low stream flows and potentially stressful temperatures. Thus, cool water and adequate rearing habitat is essential. Winter brings high flows and the need for slower water refuge habitat. The importance of cold water refugia in the action area highlights the need for preservation and restoration of riparian shading and micro-climate functions. Harvest using the 100-foot buffers along Class II streams in Class A watersheds where temperature is already near or exceeding suitable levels for salmonids should help to maintain adequate temperatures for juvenile development as well as provide an adequate temperature buffer in a future warming climate. The smaller buffers and limited canopy retention requirements on Class II watercourses in Class B watersheds may result in warming of potentially important cold water refugia sites, which could impact Chinook and steelhead juvenile survival in the long-term. In addition to potentially reducing the fitness levels of individuals exposed to conditions which cause thermal stress, exposed individual salmonids may be forced to relocate to other areas, possible increasing competitive pressures as fish crowd into already occupied habitat. High levels of competitive pressure may also result in reduced fitness of individuals who are not able to outcompete other salmonids in the system. Such individuals may suffer from inadequate growth, starvation, and increased susceptibility to predation.

### 8.3.4 Smolt

The dominant effect of the proposed action will likely be the exposure of emerging and rearing juveniles of all three covered species to sediment through the smothering of redds, reduced growth, reduced pool depth, and spacing. The most likely intermittent pulses of sediment to watercourses that support salmonids could have a negative impact on juvenile-to-smolt survival rates resulting in fewer smolts being produced that survive to adulthood.

Juvenile salmonids most susceptible to these sediment-related events are coho salmon and steelhead as they overwinter in freshwater, and often in their natal or a neighboring tributary, subjecting them to higher probabilities of being exposed to high pulses of sediment that may invoke adverse responses. In contrast, Chinook salmon fry upon emergence from redds begin their descent to mainstem channels and the estuary where they rear in the spring prior to ocean entry. With implementation of the HCP, however, we anticipate that the current baseline sediment producing events are likely to diminish over time. Although we do not expect that implementation of the HCP will result in an elimination of adverse sediment events, we do expect that the size, frequency, and duration of these events will diminish over time, resulting in an increased juvenile-to-smolt survival rate in the plan area.

The dominant stress to individual smolts in the Klamath Basin as a whole is the lack of quality water, particularly in dry years as irrigation season ramps up in the upper Klamath Basin, which affects available water downstream of Iron Gate Dam, resulting in low flows and high water temperatures. As a result of the reduced water supply, effects on smolts can include impairment on their spring migration patterns along with water quality conditions which result in disease-forming conditions that impact juvenile survival. As the proposed HCP would not include actions that draw water in any significant amount (only water drafting for roads when needed), we don't expect the proposed action will influence Klamath or Scott River mainstem flows or change channel conditions to such an extent that smolt migration patterns or survival rates will be impaired from implementation of the HCP.

### 8.3.5 Adult

The dominant stress to adults migrating into the action area is poor water quality and streamflow conditions in mainstem rivers. Once in the smaller streams of the action area, adults require adequate number and quality of pools for holding and locating spawning areas. As discussed previously, we expect that implementation of the HCP will allow for removal of existing migration barriers on the FGS ownership. We do not expect other mechanisms of barrier formation (e.g., excessive aggradation or stream dewatering) to occur as a result of the proposed action. However, there could be incidents over the duration of the permit where a large landslide blocks access to suitable upstream spawning habitat for a period of a few days to weeks depending on the magnitude of the slide and subsequent stream power which can mobilize bedload sediment and remove the blockage. Should this be the case, localized impairment to spawning may negatively affect salmonid production until the barrier is removed. Additionally, a large management-related landslide that is triggered during heavy rain events could occur over the 50-year permit duration, where the magnitude of the slide is so large that it results in the crushing and burial of migrating adults inhabiting a stream reach immediately below the landslide. We anticipate such a landslide could affect up to 0.5 miles of spawning habitat until additional rain events reestablish a main channel. NMFS expects reestablishment of a main channel through the slide would occur within a few days of the landslide event. The species most susceptible to such events would likely be SONCC coho or KMP steelhead whose spawning periods occur in months with heavy rainfall (December-March).

## 8.4 Effects on Population Viability

In the preceding discussion, we described the effects of implementing the HCP on individual life history stages of salmonids. The following discussion considers these effects on the viability of populations (question #6). For coho salmon, where the population structure has been developed (Williams et al. 2007), the affected populations include the Upper and Mid Klamath River, and the Scott River. Although population structures have not been defined for Chinook salmon and steelhead, the discussion that follows is applicable to these species as well, because their responses are expected to be similar to coho salmon given their similar habitat requirements.

### 8.4.1 Effects on spatial distribution

We do not expect implementation of the HCP to reduce the spatial distribution of the three salmonid species. Any instances of road-related migration barriers will be upgraded to provide passage as part of the roads program. Thus, implementation of the HCP may increase the distribution of salmonids in the action area. Habitat conditions will likely show some improvement over the long term and any shorter-term pulses of disturbance from HCP-related activities will not likely be of sufficient magnitude to restrict the distribution of salmonids in the action area for any extended period of time.

### 8.4.2 Effects on abundance and productivity

As we noted in the *Environmental Baseline* section, several factors are responsible for the currently depressed status of salmonids in the action area – many of which are beyond the influence of FGS' proposed activities (e.g., altered mainstem flows and water quality conditions).

Although as previously described, there may be instances of management-related landslides that affect isolated stream reaches for a period of time, over the extent of the entire plan area NMFS anticipates an overall reduction of sediment delivery and increased wood recruitment over the term of the permit which will likely yield slight increases in the quantity and quality of habitat for multiple life stages of salmonids in the action area. Such improvement in habitat quantity and quality can result in improvements for stream productivity and salmonid abundance. Previously, we noted that these habitat quality increases will likely be somewhat moderated by continuing sediment inputs from timber harvest and road-related activities as well as reduced quantities of LWD from landslides, should they fail after harvest. Localized increases in stream temperatures, as discussed previously, can lead to increased competitive pressures among juvenile salmonids as they relocate to other areas with more suitable temperatures. Localized increases in competition would result in areas of decreased productivity as density-dependent processes play out. Over the course of the 50-year permit term, NMFS concludes that implementation of the proposed action and expected improvements in habitat conditions as lands become managed under the HCP, will allow for the *potential* for increased abundance and productivity throughout the plan area.

### 8.4.3 Effects on diversity

The increases in habitat quality and quantity expected as a result of the HCP have the potential for increasing the diversity of salmonids using the action area. For example, increased pool depths could provide better holding habitat for summer steelhead. However, given the historic and ongoing disturbances that will accompany implementation of the HCP, a complete range of habitat conditions that summer steelhead evolved with will not likely be experienced. We attribute this primarily to continued sediment altering habitat conditions and reduced quantities of LWD originating from landslides should they fail after harvest. Overlaying this is also the numerous other limiting factors in the action area that have constrained the diversity of native salmonids. Overall, we expect implementation of the HCP will have little, if any, influence on the diversity of salmonids in the action area.

## 8.5 Effects on ESU viability

In the preceding discussion, we summarized the effects of implementing the HCP on the viability of populations in the action area. The discussion was applicable to all three species since the effects on habitat will translate to effects on viability parameters for the three species in a similar fashion. Viability for these species is expected to change only slightly due to the magnitude of expected effects and the continuing presence of other limiting factors in the action area. The discussion that follows links the above-mentioned effect on populations to the ESU as a whole.

### 8.5.1 Role of Klamath River diversity stratum

Populations within the SONCC coho salmon ESU are grouped into seven diversity strata to reflect geographic, climatic and environmental variation (Williams et al 2006). Three large coastal basins penetrate far inland to high elevation areas influenced by snowmelt and warmer summer and colder winter temperatures (Rogue, Klamath-Trinity and Eel Rivers). Smaller coastal basins, characterized by moderate air temperatures, low elevation, and relatively high precipitation levels, are grouped into three strata in a north-to-south fashion. Collectively, these strata are intended to ensure that diversity and spatial structure is maintained across the ESU at a scale larger than individual populations. The action area overlies a portion of the Central Interior SONCC coho diversity stratum and encompasses three of the Functionally Independent populations in the stratum.

### 8.5.2 Effects to diversity stratum and ESU

Although we acknowledge that implementation of the HCP and continued timber operations in the HCP area may result in some level of adverse effects to multiple life stages of the three covered salmonids at discreet points in time, given the ownership patterns within the action area, the magnitude of habitat responses expected, and the responses of affected populations, we do not expect the HCP to have an appreciable effect on species viability at the diversity stratum level as the total extent of salmonid habitat FGS can influence in this stratum is fairly limited. Similarly, at the scale of the ESU, we do not expect implementation of the HCP to have ESU-level influences.

## 8.6 Effects on Critical Habitat

### 8.6.1 SONCC Coho Salmon

We anticipate implementation of the HCP over the long term will improve SONCC coho salmon critical habitat as riparian and stream conditions in the HCP area recover and improve with implementation of the HCP conservation measures. The implementation of the HCP is likely to lead to some level of reduction in rates of mass-wasting from unstable areas and roads, reducing the rate of sediment delivery to salmonid habitat in the action area. In addition, wide buffers and limited ability to harvest WLPZ trees in Class A watersheds will over time improve LWD recruitment processes in these systems, leading to improvements in pool-forming conditions and the retention of cold water refugia sites. Implementation of a road program that will improve access to habitat by all life stages of coho may actually expand the areas considered to qualify as coho critical habitat over time. Although there will likely be instances where road-related sediment delivery occurs and landslides deliver high levels of sediment to a specific watershed, we anticipate these events will be limited in area due to the major factor that FGS manages so few lands adjacent to coho streams, and duration. Such events will likely result in a decrease in critical habitat quality (rearing and spawning) in the affected area, but overall we expect habitat quality, and thus the conservation value of that habitat, to improve throughout the duration of the permit. Therefore, we have determined that implementation of the proposed action is not likely to appreciably diminish the value of designated critical habitat for the conservation of SONCC coho salmon.

# 9 CONCLUSION

After considering the best available scientific and commercial information, the current status of SONCC coho salmon, and their designated critical habitat, the environmental baseline for the action area, the effects of the proposed HCP, and cumulative effects in the action area, it is NMFS' biological opinion that issuance of an ITP to FGS and implementation of the FGS HCP as proposed, is not likely to jeopardize the continued existence of SONCC coho salmon, and is not likely to result in the destruction or adverse modification of SONCC coho salmon critical habitat.

Additionally, after reviewing the current status of KMP steelhead, Upper Klamath and Trinity Rivers Chinook salmon, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects in the action area, it is NMFS' biological opinion that implementation of the proposed HCP is not likely to jeopardize the continued existence of KMP steelhead, or Upper Klamath and Trinity Rivers Chinook salmon.

# 10 INCIDENTAL TAKE STATEMENT

Take is defined as to harass, harm, pursue, hunt, shoot, kill, trap, capture or collect, or attempt to engage in any such conduct [ESA section 3(19)]. NMFS further defines "harm" as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering" (50 C.F.R. § 222.102). Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity. Under the terms of sections 7(b)(4) and 7(o)(2) of the ESA, taking that is incidental to and not the purpose of the agency action is not considered a prohibited taking, provided that such taking is in compliance with the terms and conditions of this incidental take statement (ITS).

The proposed action, issuing an ITP, does not cause incidental take; it authorizes the incidental take occurring during the conduct of covered activities according to the provisions of the HCP. The ITP itself does not permit the underlying activities that cause incidental take so much as provide an authorization for the take that occurs from these activities. The incidental take that is the subject of the proposed permit and addressed in the HCP occurs mostly in the form of harm, where habitat modification, despite minimization and mitigation measures implemented via the HCP, will impair normal behavior patterns of salmonids to an extent that actually injures or kills them at some point in time. The activities that cause the habitat modification and the extent of anticipated habitat modification from implementation of the proposed HCP is summarized below.

For highly mobile animals like salmon and steelhead that reside in dynamic habitats in which the functional processes that create and maintain habitat are fluid and continuous, estimating the amount of anticipated take of individual fish from habitat modification is difficult, if not impossible, as events causing harm to habitat or individuals on managed timberlands occurs episodically without predictive capabilities. In the action area, it would be impossible to discern the number of animals injured or killed as the result of habitat modified during implementation of the HCP, and separately identify that number from the take caused by habitat modified from any of the habitat-affecting actions identified in the environmental baseline and in cumulative effects. The problem of estimating the amount of anticipated take of individuals is further complicated, if not rendered impossible, when the scale of the proposed action is considered, both in the amount of habitat potentially affected by covered activities and the duration of the permit. In instances where the number of individual animals to be taken cannot be reasonably estimated, NMFS relies on the relationship between fish and their habitat (in the form of the extent of habitat likely to be modified under the proposed action) to identify indicators of the extent of take.

## 10.1 Amount or Extent of the Take

Take is primarily anticipated in the form of "harm." Take will occur in the form of harm from habitat modified during forestry and road maintenance and related activities as described in this Opinion and HCP. Because the relationship between habitat conditions and the distribution and abundance of fish wherever these activities will occur over the permit term is unpredictable, a specific number of individuals taken cannot be practically estimated, as mentioned above. In such circumstances, NMFS uses the predicted extent of habitat modification to describe the extent of take. The prediction is based on the general relationship between habitat function and the extent to which normal behaviors can be expressed relative to habitat function. Thus, the extent of incidental take anticipated and exempted in this incidental take statement is the amount of habitat modification throughout the action area that will occur. Reinitiation of formal consultation is triggered when habitat modifications exceed those anticipated and evaluated in this Opinion.

NMFS anticipates that over the 50-year duration of the proposed action (implementation of the HCP), there will be management-related occurrences that result in adverse effects to covered species and their habitats. For example, landslides from roads are likely to occur throughout the plan area with some level of frequency regardless of implementation of the Road Management Plan which will improve road conditions as time progresses. These landslides are expected to deliver sediment to covered species habitat and may occur to such an extent that harm to habitat and or take of individuals will occur. Additionally, implementation of covered activities is likely to result in an interruption in the LWD delivery cycle over the 50-year period. However, NMFS anticipates watersheds supporting covered species will gradually increase LWD loading as compared to baseline conditions.

In terms of the amount, or extent of take, NMFS anticipates that, throughout the permit duration, all 28.8 miles of streams that support anadromy within the plan area, and some moderate extent of stream miles downstream of plan area lands, will experience sediment-generating events that may cause harm to covered species. Such harm would occur as habitat prior to the sediment–generating events, may be reduced in quantity and quality from physical changes such as increased embeddedness, loss of refugial habitat, potential for channel avulsion resulting in stranding of juveniles, and other geomorphic processes. When events such as these occur, individual fitness levels of juveniles inhabiting the area may be reduced as juveniles may be forced to seek habitat in non-impacted stream reaches. Juveniles may relocate to reaches that have less optimal conditions for normal growth and development. For example, juveniles may be forced into habitat that experiences higher summer water temperatures, contains less food resources, or is already occupied by juveniles placing all individuals into higher levels of competition for food and habitat, which may result in reduced fitness for all individuals.

We anticipate these events will occur infrequently and sporadically throughout the 50-year permit term. These events are likely to indirectly result in take of eggs, fry, and developing juveniles of all three covered species. NMFS anticipates that the direct take of an adult of any of the covered species would be a rare event as an adult would have to be physically injured or killed as a result of covered activities. This is unlikely as adults are present within close proximity to HCP lands in late fall or early winter. At this time, FGS is performing little if any timber harvest as wet-weather restrictions and snow events make harvest difficult. This makes the co-existence of timber-related activities with adult migration and spawning unlikely. Large landslides generated as a result of timber management activities could occur during adult migration and spawning and such an event could result in injury or death to an adult(s) if they were present in the direct path of the landslide. NMFS expects that a stochastic event such as this, at the exact time and place adults are present, would not be very probable given the HCP aquatic conservation strategy which is intended to reduce the likelihood of large, management-related landslides. With these expectations, NMFS determines that no more than one adult of any of the covered species will be taken during the course of the permit term from an HCP-related sediment generating event. NMFS' authorized level of take will be exceeded if more than one adult is taken during the course of the permit term from HCP covered activities. Covered activity landslide events may also directly take eggs and juveniles. Because eggs and juveniles are often widely distributed and not consistently present in stream systems with the highest likelihood of impact from FGS operations, NMFS is unable to determine the number of juveniles that may be taken during sediment generating events that are related to covered activities during the permit term.

Of the 28.8 total miles of habitat accessible to anadromy, 3.4 miles are known or suspected to support currently listed SONCC coho and Chinook salmon. Over the duration of the 50-year permit period, NMFS expects that all 28.8 miles of anadromous habitat may be exposed to stressors from the proposed action (e.g. sediment), however, NMFS cannot predict with any accuracy the degree to which stressors would result in an exposure that reduces the fitness levels of exposed individuals. Therefore, we conclude that 28.8 miles of anadromous habitat within the action area will receive stressors from the implementation of the HCP over the 50-year permit term, and that some of these stressors will result in exposure and a response that impairs the fitness of the individuals exposed to the stressor, most likely juveniles. Out of these 28.8 miles of habitat, 3.4 miles of coho and Chinook habitat are on or immediately downstream of the plan area. Beaver Creek (an important tributary) in the Upper Klamath River basin provides the most significant and quality habitat for Chinook and coho within the plan area. Therefore, 3.4 miles of habitat out of the 28.8 total miles, has the potential to receive proposed action stressors that could impair the fitness of Chinook or coho rising to a level of take. We anticipate that Beaver Creek will periodically experience inputs of sediment from the plan area that could result in take of covered species via harm to habitat, but that over time sediment producing events will diminish in size and frequency with implementation of the HCP, and that baseline habitat conditions will improve.

NMFS does not expect that the limited extent of habitat and individuals exposed to plan area stressors will result in significant reductions to the populations of Klamath River SONCC coho, Chinook, or steelhead. Exposure of individuals to plan area stressors is expected to be balanced by improvements to existing habitat with HCP implementation.

Take in the form of harm will result from the periodic altered function of watershed processes that create and maintain habitat meeting the ecological needs of the covered species. Harm may accrue from the environmental effects of timber harvest and road construction and maintenance activities in the action area described in this Opinion. Specifically, habitat modifications that may cause take will occur in the form of: (1) sediment inputs into watercourses; (2) reduction in the sources of large woody debris recruitment; and (3) warm water temperatures.

*Sediment.*

This Opinion described several instances where sediment is likely to be generated from implementation of the HCP. These sediment producing activities are categorized as either surface erosion or mass-wasting derived sediment sources. Cumulatively, these various sediment inputs will result in fine sediment in the stream bed and coarser sediment that will limit pool formation. The resulting habitat conditions may affect salmonid survival-to-emergence and juvenile rearing success. Turbidity resulting from the various sediment sources may impair juvenile salmonid growth rates, reducing their competitive abilities. These effects will be experienced to varying degrees across all salmonid-bearing watercourses in the action area. The intensity of timber harvest and road construction or maintenance will dictate much of the magnitude of delivery of sediment. Once in the channel, the effects of this sediment will be dependent on stream gradient, pre-existing sediment loads and local hydrologic conditions.

Acute and chronic sediment input will harm small numbers of juvenile lifestages of river-type Chinook salmon, steelhead, and coho salmon, which reside in riverine systems throughout the year. Adults of these species would likely avoid harm, as they are capable of leaving disturbed habitat areas during the short-term periods of high turbidity. Numbers of juveniles that will be harmed by acute sediment loading from road work is anticipated to be small wherever effects arise because the proposed action includes measures to reduce the extent of effects and fish exposure [worksite isolation, restricted work timing, and proactive measures to reduce the potential of sediment-generating events (e.g., road work prioritization and maintenance)]. In terms of expected levels of harm that occurs as result of sediment being generated during covered activities, NMFS expects that no more than 0.5 mile of occupied covered species habitat would be taken in the form of harm to habitat in any one-year period throughout the 50-year permit term. This level of harm would be caused by the smothering of redds, blockage of suitable habitat upstream of a landslide for more than a few storm events, filling of pools, or channel avulsion caused by large management-related landslides. NMFS expects such events would begin to recover after one season and the harmful effects would begin to diminish to a point where harm is no longer occurring. NMFS' authorized level of take will be exceeded if more than 0.5 mile of occupied covered species habitat is harmed, as described above, by HCP covered activities during any one-year period of the permit term.

*Large Woody Debris.*

Low rates of large woody debris recruitment will likely persist for some time throughout the action area where riparian harvest occurred under historical forest practices. These baseline conditions will improve with time during the term of the proposed ITP on all streams. The reductions in wood supply will be manifested as reduced pool complexity which will negatively affect the growth and abundance of juvenile salmonids, particularly in lower-gradient reaches where wood inputs are often a principal control on the frequency and quality of pools. Also, lack of woody debris will alter the sediment storage and routing functions. Reduced wood loads will trap less sediment in upstream reaches and allow for more rapid delivery of material to downstream, fish-bearing reaches potentially causing effects such as blocked passage due to sediment buildup described previously. In terms of harm to habitat due to the effects of covered activities on the growth and recruitment of large woody debris over the term of the ITP, NMFS does not anticipate implementation of the proposed action will significantly improve existing stand conditions over the permit term to ameliorate the current state of riparian stands with low potential to provide large, habitat-forming wood to fish-bearing streams within the action area. As the permit term progresses and FGS implements the riparian stand management strategy contained in the HCP, NMFS anticipates there will be improvement in riparian stand conditions such that there will be more and larger trees present at the end of the permit term that NMFS assumes will continue to remain protected beyond the permit term. NMFS makes this assumption based upon a reasonable expectation that FGS will continue to promote aquatic species conservation after the permit has expired, and that California Forest Practice rules, or their equivalent, will protect riparian stands that are serving to promote the conservation and recovery of listed salmonids as has been past precedent. As these riparian stands are left unharvested, they will become increasingly suitable for providing habitat-forming large wood in the event of streamside landslides, fires, or blow-down events. In summary, NMFS expects degraded riparian habitat conditions on all 13.1 miles of fish-bearing watercourses adjacent to HCP plan area lands will occur throughout the permit term, as poor riparian stand conditions for the purpose of delivering large woody debris suitable to form habitat will continue. As mentioned above, these conditions exist primarily as a result of historical forestry practices and growth of remaining riparian stands to sizes large enough to serve as large woody debris takes many decades, even centuries. Although harvest within Class I and II WLPZs will be severely restricted with implementation of the HCP, which will lead to growth of existing trees as the permit term progresses, NMFS does not expect the HCP will have a significant effect on the rate and quantity by which large wood is recruited to streams and becomes habitat-forming structures.  Overall, NMFS does expect that riparian stand growth will occur under the proposed action, and that riparian stands will be in better condition and be more suitable for long-term large woody debris recruitment potential at the end of the permit term than at the beginning of the permit term.  In summary, in terms of riparian stand conditions that provides adequate large woody debris for the development of suitable aquatic habitat conditions within the action area, NMFS anticipates that 13.1 miles of fish-bearing watercourses will continue to be harmed throughout most of the permit duration, even with implementation of the proposed action.

Additionally, the use of herbicides and the insecticide permethrin in forest management may cause reductions in the growth rates and other lethal affects to juvenile salmonids in streams adjacent to and immediately downstream of FGS lands.  We expect that FGS will adhere to existing measures to limit the chances of chemical contamination of streams as well as any additional measures that may be required by EPA or the State of California.

*Water Temperatures*
As mentioned, NMFS anticipates that the riparian buffers proposed along Class I and II watercourses in Class A lands (supporting coho and/or Chinook) will provide for generally adequate thermal protection of adjacent coho streams throughout the permit duration.  In Class B watersheds (non-coho), NMFS anticipates there could be harm to Chinook and steelhead from smaller riparian buffers provided in Class II watercourses.  Although Class II watercourses do not provide for suitable fish habitat, they do provide summer flow into Class I watercourses. NMFS anticipates that the proposed 50-100’ WLPZ along with a requirement for maintaining only 50 percent canopy cover in Class B Class II watercourses will, over the course of the permit term, not be completely effective in protecting these watercourses from high summertime air temperatures.  As FGS owns approximately one-third of the entire watershed, NMFS anticipates that Moffett Creek in the Scott Valley Management Unit, may experience an MWAT temperature increase of up to 1° C as the permit term progresses and the effects of WLPZ harvest under the proposed HCP begin to take place.  This expectation assumes the following two circumstances occur: 1) FGS harvests a majority of the Class II watercourses within the HCP plan area in this watershed throughout the permit term, and 2) average regional summertime air temperatures increase as the permit progresses.  Warming water temperatures in Class II watercourses in the Moffett Creek drainage could translate downstream to fish-bearing reaches where adults and juveniles of Chinook and steelhead are reliant on cold water inputs from small streams.  Stream warming could result in fewer areas of suitable summer rearing habitat for steelhead juveniles, and spawning habitat for fall-run Chinook.  Incidental take authorization will be exceeded if MWAT in Moffett Creek increases more than 1° C during the permit term.  Due to FGS’s small percentage of land ownership in other Class B watersheds, NMFS does not anticipate the proposed action would increase summer MWAT temperatures in a measurable way.

### 10.2 Effect of the Take

As previously described, NMFS anticipates a limited extent of habitat supporting covered species could be harmed over the 50-year duration of the permit and such harm would occur stochastically without any predictability.  NMFS also expects that habitat conditions will gradually improve as implementation of the HCP occurs, and that watershed processes important for the survival and recovery of covered species will gradually improve leading to improvements in suitable spawning and rearing habitat for all covered species.

In the accompanying biological opinion, NMFS determined that this level of anticipated incidental take is not likely to result in jeopardy to SONCC coho salmon, Klamath and Trinity Rivers Chinook salmon, or KMP steelhead.

## 10.3 Reasonable and Prudent Measures

The applicant will minimize the extent of incidental take by implementing the following Terms and Conditions.

### 10.3.1 Terms and Conditions

All conservation measures described in the final HCP (FGS, 20XX), together with the associated Implementation Agreement and the Section 10(a)(1)(B) permit issued with respect to the HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement. Such terms and conditions are nondiscretionary and must be undertaken for the exemptions under Section 10(a)(1)(B) and Section 7(o)(2) of the ESA to apply. If the permittee fails to adhere to these terms and conditions, the protective coverage of the Section 10(a)(1)(B) permit and Section 7(o)(2) may lapse. The amount or extent of incidental take anticipated with implementation of the proposed HCP is described in Section 10.1 of this Opinion and hereby incorporated as a term and condition in NMFS' accompanying Section 10(a)(1)(B) permit.

## 10.4 Reinitiation of Consultation

This concludes formal consultation on the actions and processes described in the proposed HCP and issuance of an ITP to FGS. 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 extent of incidental take (described in Section 10.1 of this Opinion) 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 the Opinion, (3) the agency action is modified in a manner that causes an effect to the listed species or critical habitat not considered in the Opinion, or (4) a new species (not a covered species) is listed or critical habitat designated that may be affected by the action. In instances where the amount of incidental take is exceeded, consultation shall be reinitiated immediately.

# 11 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, or to develop additional information. NMFS has not identified any additional conservation recommendations at this time in view of the measures contained in the proposed conservation plan.

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## APPENDIX A.

### Riparian stand data for FGS ownership

**Table 1.** Riparian Buffer Characteristics within 150 Feet of Class I Streams Based on the 2004 Forest Inventory.

| | | Trees per Acre | | | |
|---|---|---|---|---|---|
| **Planning Watershed** | **Acres** | **4–10 inches** | **12–16 inches** | **18–22 inches** | **24+ inches** |
| Klamath River | | | | | |
| Beaver | 319.1 | 81.5 | 12.8 | 4.3 | 3.3 |
| Cottonwood | 448.5 | 66.4 | 17.8 | 8.0 | 2.5 |
| Doggett | 42.1 | 65.0 | 14.7 | 3.7 | 2.0 |
| Dona | 17.4 | 100.7 | 8.7 | 6.3 | 1.0 |
| Dutch Creek | 0.0 | | | | |
| Elliott Creek | 82.5 | 82.6 | 12.7 | 8.7 | 7.0 |
| Empire Creek | 0.0 | | | | |
| Horse | 82.9 | 56.3 | 10.9 | 5.0 | 1.0 |
| Lumgrey Creek | 10.2 | 249.0 | 15.0 | 5.0 | 1.5 |
| Seiad | 3.1 | 236.0 | 25.0 | 2.5 | 0.0 |
| Scott Valley | | | | | |
| Big Ferry | 0.0 | | | | |
| Canyon | 26.3 | 129.0 | 21.0 | 5.0 | 1.3 |
| EF Scott | 197.0 | 96.9 | 22.9 | 4.1 | 1.0 |
| Indian | 8.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| Meamber | 0.0 | | | | |
| Mill | 0.0 | | | | |
| Moffett | 239.0 | 86.8 | 16.0 | 4.3 | 0.3 |
| Pat Ford | 0.0 | | | | |
| Patterson | 0.0 | | | | |
| Rattlesnake | 0.0 | | | | |
| Yreka | 0.0 | | | | |
| Grass Lake | | | | | |
| Antelope Creek | 13.3 | 160.7 | 37.0 | 6.7 | 0.7 |
| Antelope Sink | 86.5 | 58.0 | 9.0 | 5.0 | 0.3 |
| Bogus Creek | 49.2 | 27.8 | 15.8 | 7.5 | 1.0 |
| Fourmile Hill | 0.0 | | | | |
| Garner Mtn. | 149.9 | 52.1 | 23.8 | 10.1 | 1.4 |
| Glass Mtn. | 0.0 | | | | |
| Grass Lake | 111.6 | 87.2 | 14.6 | 3.0 | 0.3 |
| Headwaters | 116.2 | 79.6 | 18.4 | 5.2 | 2.1 |
| Horsethief | 0.0 | | | | |
| Juanita Lake | 0.0 | | | | |
| Little Shasta | 0.0 | | | | |
| NW Mt. Shasta | 0.0 | | | | |
| Shasta Valley | 0.0 | | | | |
| Shasta Woods | 0.0 | | | | |

| Planning Watershed | Acres | Trees per Acre | | | |
|---|---|---|---|---|---|
| | | 4–10 inches | 12–16 inches | 18–22 inches | 24+ inches |
| Willow Creek | 0.0 | | | | |

Note: FGS hydrology layer buffered according to DFG Coho Recovery Plan specifications and overlain on the FGS 2004 Forest Inventory.

**Table 2.** Riparian Buffer Characteristics within 75 to 125 Feet of Class II Streams Based on the 2004 Forest Inventory

| Planning Watershed | Acres | Trees per Acre | | | |
|---|---|---|---|---|---|
| | | 4–10 inches | 12–16 inches | 18–22 inches | 24+ inches |
| Klamath River | | | | | |
| Beaver | 1062.8 | 74.5 | 10.4 | 4.2 | 2.0 |
| Cottonwood | 676.2 | 93.8 | 22.3 | 11.2 | 3.3 |
| Doggett | 319.0 | 60.0 | 15.8 | 8.1 | 3.3 |
| Dona | 201.2 | 32.2 | 9.0 | 5.0 | 2.8 |
| Dutch Creek | 113.0 | 90.8 | 16.1 | 11.0 | 3.9 |
| Elliott Creek | 459.1 | 56.8 | 14.2 | 9.4 | 7.5 |
| Empire Creek | 132.6 | 140.2 | 17.5 | 5.9 | 2.2 |
| Horse | 825.5 | 40.9 | 9.4 | 3.7 | 1.3 |
| Lumgrey Creek | 88.2 | 100.0 | 14.8 | 4.9 | 1.7 |
| Middle Klamath | 74.3 | 94.3 | 15.3 | 4.5 | 1.8 |
| Seiad | 65.0 | 132.6 | 23.2 | 6.9 | 2.6 |
| Scott Valley | | | | | |
| Big Ferry | 85.3 | 79.9 | 15.3 | 7.1 | 3.2 |
| Canyon | 19.7 | 193.5 | 31.5 | 7.5 | 2.0 |
| EF Scott | 225.6 | 85.8 | 14.4 | 3.3 | 0.3 |
| Indian | 75.3 | 92.3 | 13.9 | 6.0 | 1.1 |
| Meamber | 185.4 | 130.0 | 24.8 | 10.4 | 2.6 |
| Mill | 42.3 | 87.1 | 16.0 | 3.5 | 0.9 |
| Moffett | 462.7 | 79.8 | 15.4 | 4.0 | 0.4 |
| Pat Ford | 7.4 | 128.0 | 18.0 | 9.5 | 2.0 |
| Patterson | 61.1 | 134.0 | 23.1 | 12.4 | 4.5 |
| Rattlesnake | 62.0 | 110.2 | 19.0 | 5.6 | 2.4 |
| Yreka | 0.0 | | | | |
| Grass Lake | | | | | |
| Antelope Creek | 0.0 | | | | |
| Antelope Sink | 0.0 | | | | |
| Bogus Creek | 62.5 | 49.3 | 21.9 | 7.1 | 0.9 |
| Fourmile Hill | 0.0 | | | | |
| Garner Mtn. | 0.0 | | | | |
| Glass Mtn. | 0.0 | | | | |
| Grass Lake | 169.4 | 93.1 | 14.3 | 3.8 | 0.7 |
| Headwaters | 26.8 | 172.7 | 56.3 | 10.3 | 0.7 |
| Horsethief | 81.1 | 116.2 | 14.7 | 3.2 | 0.4 |

| Planning Watershed | Acres | Trees per Acre | | | |
|---|---|---|---|---|---|
| | | 4–10 inches | 12–16 inches | 18–22 inches | 24+ inches |
| Juanita Lake | 13.1 | 188.0 | 15.0 | 0.0 | 0.0 |
| Little Shasta | 4.9 | 129.9 | 26.1 | 9.6 | 1.0 |
| NW Mt. Shasta | 0.0 | | | | |
| Shasta Valley | 17.1 | 73.9 | 5.3 | 1.3 | 0.3 |
| Shasta Woods | 32.1 | 83.9 | 17.5 | 3.0 | 0.0 |
| Willow Creek | 42.9 | 59.4 | 10.3 | 4.1 | 0.5 |

Note: FGS hydrology layer buffered according to DFG Coho Recovery Plan specifications and overlain on the FGS 2004 Forest Inventory

**Table 3.** Riparian Buffer Characteristics within 25 to 50 Feet of Class III Streams Based on the 2004 Forest Inventory

| Planning Watershed | Acres | Trees per Acre | | | |
|---|---|---|---|---|---|
| | | 4–10 inches | 12–16 inches | 18–22 inches | 24+ inches |
| Klamath River | | | | | |
| Beaver | 295.3 | 85.8 | 12.7 | 5.4 | 1.9 |
| Cottonwood | 272.4 | 80.6 | 16.9 | 8.7 | 2.5 |
| Doggett | 120.9 | 54.1 | 15.9 | 4.5 | 1.9 |
| Dona | 51.7 | 41.6 | 8.5 | 5.0 | 2.1 |
| Dutch Creek | 34.7 | 95.3 | 13.5 | 8.3 | 3.8 |
| Elliott Creek | 8.4 | 41.8 | 6.8 | 5.3 | 2.8 |
| Empire Creek | 22.6 | 160.6 | 19.5 | 6.5 | 2.7 |
| Horse | 116.1 | 67.8 | 14.8 | 6.0 | 1.9 |
| Lumgrey Creek | 68.0 | 96.6 | 14.7 | 4.6 | 1.5 |
| Middle Klamath | 38.5 | 57.9 | 7.6 | 1.9 | 0.3 |
| Seiad | 102.3 | 86.8 | 18.7 | 5.5 | 2.1 |
| Scott Valley | | | | | |
| Big Ferry | 61.1 | 70.9 | 11.5 | 5.6 | 2.2 |
| Canyon | 28.2 | 114.5 | 26.0 | 5.5 | 1.0 |
| EF Scott | 135.1 | 101.6 | 18.8 | 4.2 | 0.6 |
| Indian | 190.3 | 76.8 | 13.1 | 5.0 | 1.2 |
| Meamber | 149.0 | 131.4 | 23.1 | 8.6 | 1.8 |
| Mill | 39.3 | 50.7 | 10.0 | 3.3 | 0.8 |
| Moffett | 547.2 | 79.7 | 14.6 | 4.2 | 1.0 |
| Pat Ford | 16.5 | 95.0 | 16.1 | 5.3 | 1.1 |
| Patterson | 80.0 | 104.2 | 20.5 | 10.0 | 3.3 |
| Rattlesnake | 60.6 | 84.9 | 16.8 | 6.2 | 2.0 |
| Yreka | 5.8 | 193.5 | 11.5 | 6.0 | 0.0 |
| Grass Lake | | | | | |
| Antelope Creek | 0.0 | | | | |
| Antelope Sink | 0.0 | | | | |
| Bogus Creek | 31.4 | 58.1 | 11.9 | 6.1 | 1.3 |
| Fourmile Hill | 8.6 | 64.0 | 18.0 | 2.0 | 0.0 |

| Planning Watershed | Acres | Trees per Acre | | | |
|---|---|---|---|---|---|
| | | 4–10 inches | 12–16 inches | 18–22 inches | 24+ inches |
| Garner Mtn. | 5.9 | 82.5 | 24.0 | 12.5 | 1.0 |
| Glass Mtn. | 36.3 | 182.3 | 15.1 | 2.9 | 0.3 |
| Grass Lake | 38.5 | 58.1 | 8.1 | 2.4 | 0.3 |
| Headwaters | 1.1 | 168.0 | 25.7 | 10.0 | 0.7 |
| Horsethief | 5.9 | 80.1 | 17.1 | 2.2 | 0.0 |
| Juanita Lake | 2.2 | 94.0 | 7.5 | 0.0 | 0.0 |
| Little Shasta | 23.5 | 71.5 | 10.8 | 4.3 | 0.4 |
| NW Mt. Shasta | 34.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| Shasta Valley | 13.9 | 63.6 | 6.6 | 1.0 | 0.3 |
| Shasta Woods | 7.0 | 122.4 | 22.4 | 2.8 | 0.2 |
| Willow Creek | 3.6 | 139.0 | 18.5 | 7.5 | 1.0 |

Note: FGS hydrology layer buffered according to DFG Coho Recovery Plan specifications and overlain on the FGS 2004 Forest Inventory

**Table 4.** Riparian Zone Characteristics in the HCP Area, 1997 to 2003

| Stream | Trees per Acre | | | Basal Area per Acre | | | QMD | Shade* % |
|---|---|---|---|---|---|---|---|---|
| | Conifer | Hardwood | Total | Conifer | Hardwood | Total | | |
| WF Beaver Creek | 32.3 | 198.0 | 230.3 | 34.4 | 71.4 | 105.8 | 9.2 | 76 |
| WF Cottonwood Creek | 78.8 | 103.4 | 182.2 | 69.6 | 63.6 | 133.1 | 12.0 | 91 |
| Doggett Creek | 18.4 | 143.9 | 162.3 | 34.5 | 80.3 | 114.8 | 11.6 | 99 |
| Moffett Creek | 54.4 | 36.3 | 90.7 | 53.8 | 40.3 | 94.0 | 13.8 | 56 |
| Patterson Creek | 22.3 | 129.0 | 151.3 | 26.8 | 42.5 | 69.3 | 9.2 | 64 |

* Average canopy closure measured at thalweg of pools using a hemispherical densitometer.

**Table 5.** Percentage of Class II WLPZs by Zone Width

| Implementation Class | Drainage | Acres | 75' WLPZ | 100' WLPZ | 125' WLPZ |
|---|---|---|---|---|---|
| A | Beaver | 1,060 | 36*percent* | 44*percent* | 20*percent* |
| A | Big Ferry | 30 | 43*percent* | 33*percent* | 23*percent* |
| A | Canyon | 64 | 27*percent* | 30*percent* | 44*percent* |
| A | Cottonwood | 673 | 36*percent* | 33*percent* | 31*percent* |
| A | Doggett | 319 | 38*percent* | 47*percent* | 15*percent* |
| A | Dona | 201 | 44*percent* | 49*percent* | 7*percent* |
| A | Dutch Creek | 113 | 21*percent* | 36*percent* | 42*percent* |
| A | Empire Creek | 132 | 34*percent* | 30*percent* | 36*percent* |
| A | Horse | 824 | 27*percent* | 55*percent* | 18*percent* |
| A | Indian | 75 | 25*percent* | 39*percent* | 36*percent* |
| A | Lumgrey Creek | 88 | 50*percent* | 36*percent* | 14*percent* |
| A | Meamber | 145 | 49*percent* | 30*percent* | 21*percent* |

| | | | | | |
|---|---|---|---|---|---|
| A | Middle Klamath | 75 | 31*percent* | 31*percent* | 39*percent* |
| A | Mill | 43 | 21*percent* | 33*percent* | 47*percent* |
| A | Moffett | 43 | 47*percent* | 30*percent* | 23*percent* |
| A | Pat Ford | 62 | 35*percent* | 34*percent* | 31*percent* |
| A | Patterson | 61 | 34*percent* | 36*percent* | 30*percent* |
| A | Rattlesnake | 61 | 23*percent* | 30*percent* | 48*percent* |
| A | Seiad | 50 | 16*percent* | 20*percent* | 64*percent* |
| A | Shasta Valley | - | | | |
| **A - Subtotal** | | **4,119** | **36%** | **44%** | **27%** |
| B | Bogus Creek | 63 | 57*percent* | 24*percent* | 19*percent* |
| B | Duzel | - | | | |
| B | EF Scott | - | | | |
| B | Indian | - | | | |
| B | Little Shasta | - | | | |
| B | McConaughy | - | | | |
| B | Moffett | 353 | 47*percent* | 30*percent* | 23*percent* |
| B | Shasta Valley | - | | | |
| B | Willow Creek | 43 | 79*percent* | 16*percent* | 5*percent* |
| **B - Subtotal** | | **459** | **51%** | **28%** | **21%** |
| C | Antelope Creek | - | | | |
| C | Antelope Sink | - | | | |
| C | Elliott Creek | 458 | 14*percent* | 43*percent* | 43*percent* |
| C | Fourmile Hill | - | | | |
| C | Garner Mtn | - | | | |
| C | Glass Mtn | - | | | |
| C | Grass Lake | 169 | 89*percent* | 11*percent* | 0*percent* |
| C | Headwaters | 26 | 92*percent* | 8*percent* | 0*percent* |
| C | Horsethief | 81 | 98*percent* | 2*percent* | 0*percent* |
| C | Juanita Lake | 13 | 54*percent* | 38*percent* | 8*percent* |
| C | Little Shasta | 5 | 80*percent* | 20*percent* | 0*percent* |
| C | NW Mt Shasta | - | | | |
| C | Shasta Valley | - | | | |
| C | Shasta Woods | 32 | 100*percent* | 0*percent* | 0*percent* |
| **C - Subtotal** | | **784** | **46%** | **29%** | **25%** |
| | | | | | |
| **Ownership Total** | | **5,362** | **37%** | **39%** | **24%** |

## APPENDIX B.

**Common in-stream measurements used to describe sediment levels in streams along with ranges for species needs.**

### A. Embeddedness.

The degree to which cobbles or gravel at pool tail crests is buried in fine sediment or sand is known as embeddedness, a measurement made routinely in salmonid habitat typing surveys (CDGF 2004). Pool tail crests are often chosen as locations for salmon and steelhead redd construction. Embeddedness, therefore, is one measure of spawning habitat quality. Female salmonids may expend considerably more energy excavating redds, for example, if embeddedness is high. High levels of embeddedness are indicative of high fine sediment supplies, which can resettle after redd construction to decrease egg and alevin survival. Coho salmon fry and juveniles can hide within the interstitial spaces of a cobbled stream. Embeddedness is therefore also an inverse index of available cover for coho salmon fry and juveniles.

Armentrout et al. (1999) set targets for embeddedness in volcanic watersheds west of Mt Lassen, in Mill, Deer and Antelope creeks as follows: less than 10*percent* for mainstems, less than 15*percent* for tributaries without highly erodible soils (rhyolite), and less than 20*percent* for tributaries in watersheds with rhyolitic soils.

CDFG (2004) rated embeddedness scores of less than 25*percent* as good, while NMFS (1996) rated embeddedness of less than 20*percent* as properly functioning. NMFS also gave an "at risk" rating of 20-30*percent* and a "not properly functioning" value to embeddedness greater than 30*percent*.

### B. Pool Depth.

Maximum pool depth is partly a function of watershed size, but pool depths and volume can be compromised by sediment over-supply or increased peak discharges related to upstream or upslope land management (Montgomery and Buffington 1993). Greater pool depth provides more cover and rearing space for coho and other juvenile salmonids. Deeper pools also create better shelter for migrating and spawning adults. Pool depths of three feet, or one meter, are commonly used as a reference for fully functional salmonid habitat (Overton et al. 1993, USFS 1998, Bauer and Ralph 1999, Brown et al. 1994).

### C. Pool Frequency.

Pools are preferred habitat for juvenile coho (Reeves et al. 1988). Pool frequency by percent length is preferable to pool frequency by occurrence because the latter may give a false impression of health if there are numerous, shallow, short pools as a result of aggradation. Reeves et al. (1993) found that pools diminished in frequency in intensively managed watersheds. Streams in Oregon coastal basins with low timber harvest rates (<25*percent*) had

10-47*percent* more pools per 100 m than did streams in high harvest basins (>25*percent*). Alaska studies showed ranges of 39-67*percent* percent pools by length (Murphy et al. 1984). The Washington State Fish and Wildlife Commission (1997) recommends the following pool frequencies by length:

> "For streams less than 15 meters wide, the percent pools should be greater than 55*percent*, greater than 40*percent* and greater than 30*percent* for streams with gradients less than 2*percent*, 2-5*percent* and more than 5*percent*, respectively."

Peterson et al. (1992) used 50*percent* pools as a reference for good salmonid habitat and recognized streams with less than 38*percent* pools by length as impaired. The Oregon Department of Fish and Wildlife (ODFW 2001, 002a) uses pool area as a measure of frequency and their ratings for habitat quality range from less than 10*percent* equaling poor habitat quality, to greater than 35*percent* pools as good habitat quality (ODFW 2002b).

**D. Fine Sediment (< 1mm).**

Sediment less than 1 mm in diameter can reduce bed permeability and reduce coho salmon egg and alevin survival thereby (McNeil and Ahnell 1964). McHenry et al. (1994) measured conditions inside redds and the resulting salmonid alevin emergence in Olympic Peninsula streams. These investigators found that when wet-sieved fine sediment samples of 0.85 mm or less were greater than 13*percent*, the survival of coho salmon and steelhead eggs approached zero.

Regional sediment reduction plans by the U.S. EPA (1998, 1999) and the North Coast Regional Water Quality Control Board (2006) use the threshold of 0.85 mm for fine sediment and a target of less than 14*percent*. NMFS' (1996) *Draft Guidelines for Salmon Conservation* recognized less than 12*percent* fines less (<0.85 mm) as Properly Functioning Condition, 12-17*percent* as At Risk and greater than 17*percent* as Not Properly Functioning.

Fines less than 1 mm have an affinity for moisture and dry sieve samples may be substantially lower than wet sieve samples as a result. According to Shirazi and Seim (1979), a conversion factor of 0.739 can be applied to dry-sieved samples less than 0.85 mm to make them comparable to wet sieved samples.

**E. Sand-sized Particles (<6.4mm).**

Fine sediment less than 6.4 mm is sand and very small gravel that can infiltrate into the cobble-gravel matrix above redds, reduce permeability, cause coho salmon egg mortality, and prevent the emergence of alevin (McNeil and Ahnell 1964). Kondolf (2003) surveyed the literature and found that when wet-sieved samples of fines less than 6.4 mm exceeded 30*percent* that greater than 50*percent* salmonid egg mortality resulted. The *Garcia River TMDL* (U.S. EPA 1998) set a target of <30*percent* for fine sediment <6.4 mm. The NCRWQCB (2006) recognizes this same standard.

Again, dry sieve samples, while a standard stream substrate sampling technique, yield different results than wet sieve samples. Shirazi and Seim (1979) recommended a correction factor of

0.866, when comparing sand sized (<6.4 mm) wet and dry sieved samples. The resulting reference values for dry sieve samples are, then: Poor = >25.8*percent*, Fair = 21.5-25.8*percent*, Good = 12.9-21.5*percent*, and Very Good = <12.9*percent*.

## APPENDIX C.

## Roads data for FGS ownership

Table 1. Miles of Road and Road Density in Planning Watersheds

| | Miles by Owner | | | | | | |
|---|---|---|---|---|---|---|---|
| Planning Watershed | Federal | FGS | Other Private | State | Total Miles | FGS Density (mi/mi$^2$) | Overall Density (mi/mi$^2$) |
| Klamath River | 738 | 667 | 426 | 1 | 1,832 | | |
| Beaver | 266 | 179 | 65 | | 509 | 6.8 | 4.7 |
| Cottonwood | 55 | 173 | 97 | | 324 | 6.8 | 3.3 |
| Doggett | 18 | 47 | 4 | | 69 | 7.6 | 5.8 |
| Dona | 15 | 27 | 15 | | 56 | 6.8 | 4.2 |
| Dutch Creek | 3 | 27 | 7 | | 37 | 5.7 | 3.6 |
| Elliott Creek | 39 | 41 | 12 | | 92 | 5.8 | 2.8 |
| Empire Creek | 11 | 29 | 1 | 1 | 42 | 7.0 | 4.5 |
| Horse | 98 | 100 | 19 | | 217 | 6.6 | 3.6 |
| Lumgrey Creek | 12 | 28 | 2 | | 41 | 7.1 | 4.8 |
| Middle Klamath | 188 | 9 | 162 | | 360 | 3.4 | 1.5 |
| Seiad | 33 | 8 | 43 | | 85 | 3.7 | 1.6 |
| Scott Valley | 215 | 337 | 479 | 0 | 1,032 | | |
| Big Ferry | 2 | 11 | 0 | | 13 | 5.3 | 1.3 |
| Canyon | 28 | 17 | 37 | | 82 | 5.7 | 4.1 |
| Duzel | 2 | 0 | 9 | | 11 | 0.0 | 1.1 |
| EF Scott | 48 | <0.1 | 101 | | 149 | 0.1 | 1.3 |
| Indian | 22 | 41 | 28 | | 91 | 6.6 | 4.2 |
| McConaughy | 9 | 1 | 32 | | 42 | 6.8 | 1.1 |
| Meamber | 0 | 51 | 25 | | 76 | 6.5 | 5.9 |
| Mill | 27 | 16 | 38 | | 81 | 7.2 | 3.6 |
| Moffett | 58 | 145 | 141 | 0 | 344 | 4.7 | 2.3 |
| Pat Ford | 5 | 27 | 1 | | 32 | 7.9 | 2.7 |
| Patterson | 6 | 18 | 4 | | 28 | 5.4 | 4.4 |
| Rattlesnake | 7 | 10 | 31 | | 48 | 6.0 | 2.7 |
| Yreka | 1 | 1 | 33 | 0 | 35 | 3.7 | 1.4 |
| Grass Lake | 724 | 349 | 558 | | 1,631 | | |
| Antelope Creek | 34 | 2 | 39 | | 75 | 3.5 | 2.5 |
| Antelope Sink | 23 | 12 | 2 | | 37 | 4.8 | 0.8 |
| Bogus Creek | 19 | 19 | 6 | | 45 | 6.3 | 0.8 |
| Fourmile Hill | 103 | 6 | | | 109 | 4.8 | 1.6 |
| Garner Mtn. | 33 | 13 | 3 | | 48 | 5.8 | 1.6 |
| Glass Mtn. | 63 | 13 | 4 | | 80 | 4.2 | 1.1 |
| Grass Lake | 35 | 86 | 74 | | 196 | 4.6 | 2.3 |
| Headwaters | 25 | 36 | 24 | | 85 | 4.8 | 2.6 |
| Horsethief | 107 | 40 | 27 | | 175 | 3.8 | 1.9 |
| Juanita Lake | 32 | 15 | 11 | | 57 | 4.8 | 1.3 |
| Little Shasta | 57 | 48 | 46 | | 151 | 5.0 | 2.5 |
| NW Mt. Shasta | 61 | 12 | 26 | | 99 | 2.4 | 0.6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Shasta Valley | 14 | 9 | 234 | 257 | 4.5 | 0.6 |
| Shasta Woods | 116 | 32 | 23 | 172 | 4.6 | 3.0 |
| Willow Creek | 1 | 7 | 37 | 45 | 4.7 | 1.2 |

Table 2. Number of Stream Crossings on Streams in the HCP Area

| | **Stream Class** | | |
|---|---|---|---|
| **Planning Watershed** | **1 (Fishbearing)** | **2** | **3** |
| Klamath River | | | |
| Beaver | 11 | 179 | 159 |
| Cottonwood | 14 | 72 | 114 |
| Doggett | 2 | 78 | 80 |
| Dona | 1 | 42 | 25 |
| Dutch Creek | 0 | 12 | 11 |
| Elliott Creek | 2 | 67 | 3 |
| Empire Creek | 0 | 13 | 13 |
| Horse | 1 | 147 | 62 |
| Lumgrey Creek | 0 | 10 | 27 |
| Middle Klamath | 0 | 6 | 5 |
| Seiad | 0 | 2 | 14 |
| Scott Valley | | | |
| Big Ferry | 0 | 9 | 20 |
| Canyon | 0 | 10 | 42 |
| Indian | 1 | 6 | 64 |
| Meamber | 0 | 23 | 85 |
| Mill | 0 | 3 | 12 |
| Moffett | 12 | 41 | 191 |
| Pat Ford | 0 | 5 | 19 |
| Patterson | 0 | 6 | 30 |
| Rattlesnake | 0 | 10 | 18 |
| Grass Lake | | | |
| Antelope Creek | 0 | 0 | 0 |
| Antelope Sink | 1 | 0 | 0 |
| Bogus Creek | 3 | 2 | 12 |
| Fourmile Hill | 0 | 0 | 2 |
| Garner Mtn. | 4 | 0 | 3 |
| Glass Mtn. | 0 | 0 | 12 |
| Grass Lake | 5 | 15 | 12 |
| Headwaters | 3 | 4 | 1 |
| Horsethief | 0 | 4 | 3 |
| Juanita Lake | 0 | 1 | 1 |
| Little Shasta | 0 | 1 | 8 |
| NW Mt. Shasta | 0 | 0 | 8 |

| | | | |
|---|---|---|---|
| Shasta Valley | 0 | 0 | 6 |
| Shasta Woods | 0 | 3 | 1 |
| Willow Creek | 0 | 3 | 2 |

Table 3. Road Inventories Conducted by FGS

| Planning Watershed | Year | Surveyor | Acres | Miles | Stream Crossings |
|---|---|---|---|---|---|
| Moffett | 2001 | SHN | 31,358 | 42.9 | 77 |
| Doggett | 2001 | RM | 7,673 | 54.07 | 134 |
| West Fork Cottonwood | 2002 | RM | 8,222 | | 0 |

Table 4. Road Improvement Projects Completed by FGS

| Planning Watershed | Description | Quantity | Total Cost |
|---|---|---|---|
| Klamath River | | | |
| Beaver | Road design: miles of road drainage improvement | 20.1 | $577,500 |
| Beaver | Stream crossings: bridges, fords, culverts | 3 | $186,000 |
| Beaver | Stabilize: slides and slumps | 8 | $190,000 |
| Cottonwood | Road design: miles of road drainage improvement | 17 | $472,500 |
| Doggett | Surface: miles of rocked road | 87.5 | $226,500 |
| Doggett | Stream crossings: bridges, fords, culverts | 3 | $199,500 |
| Doggett | Stabilize: slides and slumps | 1 | $86,000 |
| Elliott Creek | Road design: miles of road drainage improvement | 2 | $18,432 |
| Elliott Creek | Surface: miles of rocked road | 4 | $55,944 |
| Elliott Creek | Stabilize: slides and slumps | 1 | $8,234 |
| Horse | Road design: miles of road drainage improvement | 7.2 | $216,000 |
| Horse | Stabilize: slides and slumps | 6 | $232,500 |
| Scott Valley | | | |
| EF Scott | Road design: miles of road drainage improvement | 16 | $227,000 |
| EF Scott | Surface: miles of rocked road | 2.8 | $55,800 |
| EF Scott | Stream crossings: bridges, fords, culverts | 16 | $12,800 |
| Indian | Road design: miles of road drainage improvement | 2 | $60,000 |
| Indian | Surface: miles of rocked road | 1 | $6,000 |
| Meamber | Road design: miles of road drainage improvement | 0.33 | $9,900 |
| Meamber | Stream crossings: bridges, fords, culverts | 3 | $65,800 |
| Moffett | Road design: miles of road drainage improvement | 9.6 | $185,500 |
| Moffett | Surface: miles of rocked road | 1 | $1,800 |
| Moffett | Stream crossings: bridges, fords, culverts | 42 | $30,000 |
| Moffett | Stabilize: slides and slumps | 1 | $50,000 |
| Moffett | Decommission: long-term road closure and stabilization | 13.7 | $411,000 |
| Rattlesnake | Road design: miles of road drainage improvement | 0.25 | $1,250 |
| Grass Lake | | | |
| Little Shasta | Surface: miles of rocked road | 3 | $5,400 |

## APPENDIX D

## ESSENTIAL FISH HABITAT CONSULTATION

### Action Agency

National Marine Fisheries Service (NMFS)

### Project Name

Authorization of Incidental Take for the Implementation of the Fruit Growers Supply Company Multi-Species Habitat Conservation Plan.

### Essential Fish Habitat Background

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended, requires Federal agencies, including NMFS itself, to consult with NMFS on activities that may adversely affect Essential Fish Habitat (EFH).

The objective of this EFH assessment is to determine whether or not the proposed action "may adversely affect" designated EFH for relevant commercially, federally-managed fisheries species within the proposed action area. Designated EFH for both Chinook and coho salmon exist in the action area. This assessment also describes conservation measures proposed to avoid, minimize, or otherwise offset potential adverse effects to designated EFH resulting from the proposed action.

### Description of the Project/Proposed Activity

NMFS' proposed action in this intra-service EFH consultation is the issuance of an Incidental Take Permit (ITP) under Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973, as amended, to the Fruit Growers Supply Company (FGS) for FGS's implementation of the Fruit Growers Supply Company's Multi-Species Habitat Conservation Plan (HCP) for a permit period of 50 years. The HCP addresses adverse effects to species under the jurisdiction of both the U.S. Fish and Wildlife Service (USFWS), and NMFS, together the "Services." For the USFWS, covered species of the HCP includes the federally threatened northern spotted owl (*Strix occidentalis caurina*) and includes a conservation strategy for the federally endangered plant, Yreka phlox (*Phlox hirsuta*). For NMFS the covered aquatic species includes the federally threatened Southern Oregon/Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*) Evolutionarily Significant Unit (ESU), and FGS asked that NMFS include two non-listed species as covered species in the HCP; Upper Klamath and Trinity Rivers Chinook salmon (*O. tshawytcha*) ESU, and Klamath Mountains Province (KMP) steelhead (*O. mykiss*) ESU. The requested ITP would authorize the incidental taking of these two currently unlisted species at the time of listing, should NMFS determine listing of these species is necessary during the 50-year permit term of the FGS ITP.

Timber management is the primary activity conducted on FGS's HCP covered lands. The primary management activities that could result in take of salmonids include: timber harvest, yarding and transport, road building and maintenance, and silvicultural practices (e.g. clearcutting). "Covered Activities" for the FGS HCP are described in more detail in Chapter 2 of the HCP (FGS 2012). Detailed descriptions of FGS activities and conservation measures are provided in Chapter 5 of the HCP and have been summarized in section 2 *Description of the Proposed Action* of the Biological Opinion associated with this proposed action.

**EFH Assessment**

1. No Adverse Effects to Groundfish and Coastal Pelagics EFH

Project related effects (adverse and beneficial) are not expected to affect the Klamath River estuary, nearshore habitat, or offshore benthic habitat as the action area for the proposed ITP is located approximately 140 river miles upstream of the Klamath River estuary with no proposed action effects expected to influence estuary or offshore habitat or species. Therefore, NMFS anticipates no adverse effects to Groundfish and Coastal Pelagics EFH. A complete list of the species covered under the Groundfish EFH can be found at http://marinehabitat.psmfc.org/. A complete list of species covered under the Coastal Pelagics EFH can be found at: http://www.psmfc.org/efh/pelagic_efh.html.

2. Potential Adverse Effects of Proposed Project/Action

Designated EFH for both Chinook and coho salmon occurs in the following three watersheds, which overlap with the Action Area described in the Biological Opinion: Upper Klamath River, Middle Klamath River, and Scott River.

3. Adverse Effects to Salmon EFH

A. Adult Migration Pathways

Adverse effects to adult migration pathways have been described in the Biological Opinion in Section 6 *Effects of the Action*. Implementation of the HCP will improve access for adult salmonids on all lands owned by FGS. During the road inventory process outlined in the HCP, fish passage problems at existing watercourse crossings will be documented and culverts that are impeding fish passage will be prioritized for replacement with a "fish friendly" structure. Impacts caused by the blockage of fish passage would be avoided or minimized by proper culvert installation at all stream crossings or replacement with fish-friendly structures. As such, fish passage problems at watercourse crossings would be eliminated over time, most within the first 15 to 20 years of the HCP following issuance of the ITP. It is not expected that new barriers will be created as a result of any new road construction and implementation of the HCP as new crossings must ensure fish passage at the time of installation. Over the course of the first 15 years of the permit duration, implementation of the HCP will result in increased passage for adults in the Upper and Middle Klamath, and Scott Rivers, and adult migration pathways will not be adversely affected by the proposed action. Such improvements to migration pathways are expected to benefit habitat for the three different brood years of SONCC coho salmon, and the five different brood years of Chinook salmon. It is not expected that the road inventory and crossing repair work will disproportionately benefit or harm habitat of particular brood years over others, as the road work is expected to be fairly evenly distributed over the 15 year roads program.

B. Spawning and Incubation

Adverse effects to salmonid spawning and incubation habitat have been described in the Biological Opinion in Section 6 *Effects of the Action*. Chinook and coho salmon are known to spawn in the Klamath River and Scott River mainstem where suitable habitat exists (e.g., clean and appropriately sized gravels for redd building). Spawning and incubation habitat in the mainstem Klamath and Scott Rivers will be maintained and improved by implementation of the HCP. Proposed conservation measures will reduce the impacts of forest management on surface runoff and peak flows, reduce soil compaction and disturbance, increase slope stability, and maintain or enhance in-channel large woody debris (LWD). Any adverse impacts to spawning and incubation due to altered hydrology and water quality would be minimized and mitigated by the improved riparian conditions resulting from riparian management, and decreased sediment production and delivery. The implementation of the HCP will maintain or improve hydrologic processes and will likely contribute to maintenance and stability of aquatic habitat conditions in local channels. Implementation of the HCP provides additional conservation measures for management of riparian areas and roads, and slope stability measures that would minimize and reduce sediment inputs into watercourses within the Plan Area. Sediment production and delivery that could result in increased sediment loading, sedimentation, and turbidity levels would be reduced compared to conditions anticipated to occur over time without implementation of the HCP.

The reduction in sediment delivery to watercourses will benefit Chinook and coho salmon in the Upper and Middle Klamath, and Scott River population units.

C. Stream Rearing Habitat

Section 6 of the Opinion details NMFS' analysis of proposed action effects on stream rearing habitat in EFH reaches. Juvenile salmonids require cold, clean water in which to rear. Implementation of HCP riparian conservation measures would help to maintain high levels of canopy cover in the critical "inner zone" where stream shading and microclimate effects are anticipated to have the greatest potential to affect water temperatures. Overstory canopy closure is likely to increase relative to current conditions in all riparian stands adjacent to salmonid watercourses as strict riparian measures will limit the number of trees in the riparian zone available for harvest, leaving most trees to grow throughout the 50-year permit. The overall increase in overstory canopy closure is anticipated to result in minor decreases in water temperatures in Plan Area streams over the permit term.

Implementation of the road management and slope stability measures in the proposed HCP are anticipated to reduce the level of sediment delivery to the Plan Area; however management-related sediment delivery over the course of the permit period is not expected to cease. Any adverse change in water temperature as a result of sedimentation is likely to be spatially limited and temporary in nature and would be offset by the decrease in stream temperatures as a result of increased canopy coverage over the long term. It is anticipated that approximately 10 to 20 percent of hydrologically connected roads over which FGS has jurisdiction will be disconnected within the first five years. Given that water temperatures are generally favorable for the covered aquatic species throughout the Plan Area even with past and current levels of sediment delivery, reduced sediment delivery would reduce the likelihood that aggradation of channels would occur and contribute to elevated water temperatures.

It is anticipated that there would be about a 10 percent decrease in acres harvested each decade, including as much as a 25 percent decrease in even-age regeneration harvest (clearcuts). A reduction in clearcutting would contribute to maintenance or improvement of existing hydrologic conditions. Protective measures implemented under the HCP would contribute to reducing the potential for operations-related changes in surface and subsurface hydrology by minimizing soil compaction that can increase the magnitude of peak flows. The road management measures implemented would have greater influence on area hydrology through the hydrologic disconnection of the existing road network from area streams. This would have the combined effect of decreasing peak flows in affected stream channels, reducing the amount of sediment delivered to those channels, and reducing the potential for the geomorphic destabilization of the associated stream network, all of which contribute to net positive impacts on hydrology in the Plan Area.

In summary, although there may be short term increases in water temperatures from the harvesting of trees in Class II (non-fish-bearing) watercourses, NMFS anticipates that the proposed riparian measures will not result in long term adverse changes to stream temperatures, and therefore, will not have adverse effects on rearing habitat.

D. Smolt Migration Pathways

NMFS believes that that implementation of the HCP and its associated conservation measures, will have an overall positive effect on smolt migration pathways, through the removal of passage barriers, decrease in sediment inputs, and improved retention of trees in the riparian zone.

E. Marine and Estuarine Habitat

As explained for Groundfish and Coastal Pelagics EFH, because the action area occurs approximately 140 river miles upstream of the Klamath River estuary, NMFS anticipates any adverse effects from Covered Activities, such as the production of turbid waters from landslides, are ameliorated to an undetectable level before reaching any estuarine or marine habitat. Therefore, NMFS determines there are no adverse effects to Salmon EFH Estuarine and Marine Habitat from the proposed action.

**EFH Conservation Measures**

Proposed conservation measures described in the HCP will minimize the potential adverse effects to EFH by improving access to adults, improving rearing habitat, decreasing water temperatures, and reducing sediment inputs to spawning areas. These activities and effects are described in detail in the 2012 NMFS Opinion for the proposed action. Therefore, at this time, NMFS is not proposing additional conservation measures.

**Conclusion**

With issuance of an ITP there will continue to be adverse Project effects to spawning and incubation habitat, smolt migration pathways and rearing habitat in the Klamath and Scott River mainstem during the 50 year permit term. However, implementation of the HCP and associated conservation measures will mitigate and minimize adverse effects resulting in improved EFH habitat in the Upper and Middle Klamath, and Scott Rivers as compared to baseline (no ITP) conditions.