Endangered Species Act
Section 7 Consultation Biological Opinion and Section 10 Statement of Findings

And

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

Washington State Forest Practices Habitat Conservation Plan

Lead Action Agency:	National Marine Fisheries Service; United States Fish and Wildlife Service
Consultation Conducted By:	National Marine Fisheries Service, Northwest Region
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1.0 INTRODUCTION

This document prepared by National Marine Fisheries Service (NMFS) includes a Biological Opinion (Opinion) and incidental take statement in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.), and implementing regulations at 50 CFR 402. The Essential Fish Habitat (EFH) consultation was prepared in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600. The administrative record for this consultation is on file at the Washington State Habitat Office in Lacey, Washington.

NMFS prepared this Opinion under section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (ESA). The Opinion analyzes the effects of issuing an Incidental Take Permit (ITP) to the State of Washington (State) for the Forest Practices Habitat Conservation Plan (FPHCP). The State seeks the ITP, pursuant to section 10(a)(1)(B), for the incidental take of listed aquatic species (and for presently unlisted aquatic species should they become listed in the future) for a period of 50 years. The Permit would authorize incidental take of aquatic species for State and private forest landowners conducting forest practices in compliance with the Washington State Forest Practices Act and Forest Practices Rules, as described in the FPHCP. This Opinion is based on the NMFS's review of the proposed Forest Practices Habitat Conservation Plan that applies to approximately 9.3 million acres of non-Federal, non-tribal forestland and its effects on aquatic threatened and endangered species in accordance with section 7 of the Act.

The U.S. Fish and Wildlife Service (USFWS) is preparing a separate Opinion for its proposed issuance of an ITP for fish and wildlife species under its jurisdiction that would be covered under the FPHCP.

1.1 Background and Consultation History

In 1999, the Washington State Legislature passed the Salmon Recovery Funding Act (Engrossed Senate House Bill 5595) which identified forest practices as a critical component for salmon recovery. Through the Act, the Legislature recognized a report known as the Forests and Fish Report (FFR) as being responsive to its policy directive for a collaborative, incentive-based approach to support salmon recovery; ESA coverage and regulatory certainty being key incentives of implementation of the FFR. The FFR was developed though a collaborative, multi-stakeholder process to create forest practices prescriptions that would protect riparian and aquatic habitat for the conservation of listed salmon species and other unlisted fish and stream-associated amphibian species. The groups that contributed to the development of the FFR included State agencies (Washington Department of Natural Resources (DNR), Washington Department of Fish and Wildlife (WDFW), Washington Department of Ecology (DOE), and the Governor's Office), Federal agencies (USFWS, NMFS, Environmental Protection Agency (EPA)), certain Washington Tribes and the Northwest Indian Fisheries Commission, the Washington State Association of Counties, the Washington Forest Protection Association (WFPA), and the Washington Farm Forestry Association (WFFA).

Also in 1999, the Washington State Legislature passed the Forest Practices Salmon Recovery Act (Engrossed Senate House Bill 2091), which directed the Washington Forest Practices Board to adopt new forest practices rules, encouraging the Forest Practices Board to follow the recommendations of the FFR. In its rulemaking procedures, the Forest Practices Board conducted an evaluation of the FFR, as well as alternatives to the FFR. This evaluation included an Environmental Impact Statement (EIS) under the Washington State Environmental Policy Act (SEPA). The Final State Environmental Impact Statement, entitled *Alternatives for Forest Practices Rules for Aquatic and Riparian Resources*, was published in April 2001. The Forest Practices Board adopted new permanent forest practices rules in 2001 based on the FFR. As directed by the Washington State Legislature, through the Forest Practices Salmon Recovery Act, Governor Gary Locke designated the Commissioner of Public Lands, Doug Sutherland, to negotiate on behalf of the State of Washington with the relevant Federal agencies to satisfy Federal requirements under the ESA pursuant to the Revised Code of Washington (RCW), Chapter 77.85.190(3).

Since 2001, the State has worked with the USFWS and NMFS (together, the Services) to develop what has become the FPHCP, under Section 10(a)(1)(B) of the ESA, based on the forest practices rules adopted in 2001. The State submitted a formal application to the Services for ITPs from each agency on February 9, 2005. A draft of the FPHCP was released for 90-day public comment period, along with a draft EIS as directed by the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. §§ 4321-4355). The comment period began on February 11, 2005 (63 FR 68469) and closed on May 12, 2005. The Services and the State of Washington prepared a final EIS (FEIS), Response to Comments, and a final FPHCP. These documents were made available to the public on January 27, 2006 for a 30-day period.

After the close of the publication processes, NMFS and USFWS began their respective consultations under ESA section 7(a). Consultation involved coordination between the two Services. Consultation also involved collaboration with the applicant and other agencies of the State of Washington including the Department of Ecology and Department of Fish and Wildlife. Furthermore, NMFS engaged various entities from the Forest and Fish Report caucuses to review and provide critical comments and further information on the draft Biological Opinion. These included representatives of the Washington Forest Law Center (environmental), the Washington Forest Products Association (industry), and the Tribal Caucus, with the Makah Tribe and Northwest Indian Fisheries Commission providing reviews and comments. Separately, but during consultation, NMFS engaged in a Government to Government meeting with the western Washington Treaty Tribes on April 21, 2006.

This Opinion is based on the Final FPHCP, the associated Implementation Agreement, the FEIS including the Response to Public Comments, and several years of discussions and negotiations with the State and stakeholders. A complete administrative record of the FPHCP development is on file in the Services' Lacey, Washington offices. The Services initiated ESA section 7 consultation on February 9, 2005, when the applicant submitted its formal application for an ITP.

1.2 Description of the Proposed Action

The Services propose to issue ITPs in accordance with their authorities and responsibilities under ESA section 10(a)(1)(B) (*inter alia*) and relevant regulations. The permit applicant is the State of Washington. The applicant has prepared and submitted an application based upon the FPHCP which describes the manner in which certain species, listed as threatened and endangered under the ESA, as well as certain presently unlisted species, will be conserved as the applicant operates forestry programs under its jurisdiction on non-Federal lands throughout Washington State. Upon conclusion of the various processes required under NEPA and the ESA, the applicant and the Services will sign an Implementation Agreement that presents the commitments of these parties to the provisions of the FPHCP.

Based on the described process, the Services propose to issue ITPs for listed species in accordance with their authorities and responsibilities under ESA section 10(a)(1)(B) and its relevant regulations (50 CFR Part 13, 17, and 222). The permit applicant is the State of Washington. The applicant has prepared and submitted an application based upon a Habitat Conservation Plan (HCP) describing the manner in which certain species, listed as threatened and endangered under the ESA, as well as certain presently unlisted species, will be conserved as the applicant regulates forest practices on a variety of non-Federal lands throughout Washington State.

The State of Washington is requesting ITPs that cover its actions as regulator of forest practices activities on non-Federal, non-tribal land in Washington State. Coverage from the ITPs is intended to extend also to those conducting forest practices as described in the HCP on covered lands. The HCP covers certain listed and unlisted aquatic species, and this biological opinion, will analyze effects of covered activities on all covered species.

1.2.1 Lands Covered by the Forest Practices Habitat Conservation Plan

The FPHCP covers approximately 9.3 million acres of forestland in Washington, about 6.0 million acres of which are located west of the crest of the Cascade Range, and approximately 3.3 million acres are in eastern Washington. Ownership patterns range from individuals and families who own small forest parcels, to large holdings owned and/or managed by private corporations and public agencies.

Covered lands are forestlands within the state of Washington subject to the Washington Forest Practices Act, chapter 76.09 of the RCW. Forestland means "all land which is capable of supporting a merchantable stand of timber and is not being actively used for a use which is incompatible with timber growing" (RCW 76.09.010(9)). For purposes of road maintenance and abandonment planning and implementation for small forest landowners, "forestland" does not include residential home sites, crop fields, orchards, vineyards, pastures, feedlots, fish pens and land that contains facilities necessary for the production, preparation or sale of crops, fruit, dairy products, fish and livestock.

The covered lands mainly include private and state forestlands, although local government forestlands are also covered. Forestlands already covered by existing Federally approved habitat conservation plans are generally not considered part of FPHCP covered lands (WAC 222-12-

041), with two exceptions. One is the Boise Cascade single-species habitat conservation plan that encompasses 620 acres and provides coverage for the northern spotted owl, but does not include coverage for aquatic species. The other is approximately 228,000 acres of DNR managed land on the east side of the Cascade crest. The DNR State Lands HCP provides coverage for terrestrial species in this area, but does not include coverage for aquatic species. The forestland contained within these two areas is considered covered land under the FPHCP.

1.2.2 Species Covered by the Forest Practices Habitat Conservation Plan

The FPHCP provides measures to minimize and mitigate the incidental take of federally listed fish species present in Table 1, below. The applicant seeks take coverage under the ESA for threatened and endangered species. The IA and the ITP provide that a covered unlisted species that becomes listed during the term of the ITP will be covered by the ITP when becomes listed.

Table 1. Covered Species under NMFS Jurisdiction (by listing status).

Common Name	**Scientific Name**
Endangered Species	
Upper Columbia River spring-run chinook salmon	*Oncorhynchus tshawytscha*
Snake River sockeye salmon	*O. nerka*
Threatened Species	
Puget Sound chinook salmon	*Oncorhynchus tshawytscha*
Lower Columbia River chinook salmon	*O. tshawytscha*
Upper Willamette River chinook salmon	*O. tshawytscha*
Snake River spring/summer run chinook salmon	*O. tshawytscha*
Snake River fall run chinook salmon	*O. tshawytscha*
Columbia River chum salmon	*O. keta*
Hood Canal summer run chum salmon	*O. keta*
Ozette Lake sockeye salmon	*O. nerka*
Lower Columbia River steelhead	*O. mykiss*
Middle Columbia River steelhead	*O. mykiss*
Upper Columbia River steelhead	*O. mykiss*
Snake River Basin steelhead	*O. mykiss*
Upper Willamette River steelhead	*O. mykiss*

Table 1 (cont'd).

	Scientific Name
Unlisted Species	
Pink salmon (all ESUs)	*Oncorhynchus gorbuscha*
Coho salmon (all ESUs)	*O. kisutch*
Chinook salmon (all unlisted ESUs)	*O. tshawytscha*
Chum salmon (all unlisted ESUs)	*O. keta*
Sockeye salmon (all unlisted ESUs)	*O. nerka*
Steelhead (all unlisted ESUs); Puget Sound Steelhead presently proposed for listing as "threatened."	*O. mykiss*
Green sturgeon (marine fish)	*Acipensermedirostris*
White sturgeon (marine fish)	*A. transmontanus*
Eulachon (marine fish)	*Thaleichthys pacificus*
Shiner perch (marine fish)	*Cymatogaster aggregata*
Pacific staghorn sculpin (marine fish)	*Leptocottus armatus*
Starry flounder (marine fish)	*Platichthys stellatus*
Surf smelt (marine fish)	*Hypomesus pretiosus*
Pacific sandlance (marine fish)	*Ammodytes hexapterus*
Pacific herring (marine fish)	*Clupea pallasii*

1.2.3 Activities Covered by the Forest Practices Habitat Conservation Plan

Forest practices activities covered by the FPHCP include road and skid trail construction, road maintenance and abandonment, final and intermediate harvesting, pre-commercial thinning, reforestation, salvage of trees and brush control. In addition, adaptive management research and monitoring activities—some of which include experimental treatments—are also covered by the plan. The FPHCP includes measures to monitor, minimize and mitigate any impacts caused by these activities. These activities are described in HCP Chapter 4 in great detail. That information is summarized below.

The applicant developed the FPHCP as a programmatic plan providing ESA coverage for forest landowner activities conducted according to major aspects of the State's Forest Practices program. The Forest Practices program includes state statutes and rules that govern forest practices activities in Washington and the public and private agencies and organizations that work cooperatively to administer the program throughout the state. The Forest Practices program includes both the regulatory and collaborative dimensions (as described below), within the scope of the FPHCP; forest landowners would comply with the ESA by conducting forest practices activities (as described in FPHCP Chapter 2) according to the State's Forest Practices Act and rules for the protection of covered species.

The FPHCP consists of two parts, an administrative framework and a set of protection measures. The administrative framework supports the development, implementation and refinement of the State's Forest Practices Rules and therefore contributes to the overall effectiveness of the FPHCP in meeting the needs of the covered species currently and over time. The administrative framework bears on the protective aspects of the FPHCP in that it includes the Forest Practices Rules and guidance, the forest practices permitting process, compliance monitoring, taking enforcement actions, and providing training and technical support. The administrative framework also incorporates an adaptive management process to address uncertainty as to the effectiveness of protection measures. The adaptive management program is designed to assess the effectiveness of the protection measures in achieving established resource objectives. It includes programs to monitor the status and trends of key environmental parameters and to evaluate watershed-scale cumulative effects.

The protection measures relate specifically to the environmental effects of the covered activities, and therefore are the focus of this consultation and Biological Opinion. The protection measures are stated in state forest practices laws, rules, and guidance designed to minimize and mitigate forestry-related impacts and conserve habitat for species covered by the FPHCP. The protection measures determine the level of on-the-ground habitat protection for covered species. They are presented as two separate but related conservation strategies: Riparian and Upland.

1.2.3.1 Water Typing for Application of the Riparian Strategy

Before the development of the FPHCP, the State of Washington allocated forest practices protective regulations along State waters according to categories of water "types." Described in the most general way, water types based on a physical channel measurement commonly known as "bankfull width" helped define the way forest practices could be carried out near those waters. Since the water typing system proposed in the FPHCP is still under development, forest practices will be regulated under an interim water typing system, based almost entirely on the existing State water typing. Since forest practices under the FPHCP will be carried out under first the existing interim system, and then the water typing system described in the FPHCP, the Opinion describes both systems. However, the riparian protection measures are described in relation to the permanent water typing system only.

1.2.3.1.1 The Interim Water Typing System. The interim water typing system assigns a numeric "type" according to the waters' beneficial use and importance to fish, wildlife and humans. Generally, the lower the numeric value, the greater the beneficial use. Thus, Type 1 through 3 waters have more fish use than do Type 4 and 5 waters.

Type 1 waters are all waters within their ordinary high water marks that have been inventoried as "shorelines of the state" (streams and rivers carrying at least 20 cubic feet per second or lakes greater than 20 acres) but do not include those waters' associated wetlands. Generally, "shorelines of the state" include larger lakes and rivers, as well as tidally influenced areas along Washington's western coast and within the Strait of Juan de Fuca and Puget Sound.

Type 2 waters are segments of natural waters and periodically inundated areas of their associated wetlands that are not classified as Type 1 waters and that have high fish use. Type 2 waters have highly significant fish populations, and include: 1) streams with bankfull widths of at least 20 feet and gradients of less than four percent, and 2) lakes, ponds or impoundments that have surface areas of at least one acre at seasonal low water.

Type 3 waters are segments of natural waters and periodically inundated areas of their associated wetlands, which are not classified as Type 1 or 2 waters, and have moderate to slight fish, wildlife or human use. Type 3 waters are typically defined by stream channels with a bankfull width of at least two feet in western Washington or three feet in eastern Washington and a gradient of 16 percent or less; stream channels with a bankfull width of at least two feet in western Washington or three feet in eastern Washington, a gradient greater than 16 percent, and less than or equal to 20 percent, and a contributing basin size of more than 50 acres in western Washington and more than 175 acres in eastern Washington; ponds or impoundments having a surface area of less than one acre at seasonal low water and having an outlet to a fish-bearing stream; or ponds or impoundments having a surface area greater than 0.5 acre at seasonal low water.

Type 4 waters are segments of natural waters within the bankfull width of defined channels that are not fish habitat and are perennial. Type 4 designation begins at a point along the channel where the contributing basin size is at least 13 acres in the western Washington coastal zone (i.e., the Sitka spruce zone as defined by Franklin and Dryness 1973), at least 52 acres in other locations in western Washington, or at least 300 acres in eastern Washington.

Type 5 waters are segments of natural waters within the bankfull width of defined channels that are not Type 1, 2, 3 or 4 waters. These are seasonal, non-fish habitat waters where surface flow is not present for at least some portion of a year of normal rainfall and are not located downstream from any stream reach that is classified as a Type 4 water. Type 5 waters must be physically connected to Type 1, 2, 3 or 4 waters by an above-ground channel.

1.2.3.1.2 The Permanent Water Typing System. The permanent water typing system used to allocate the Riparian Protection Strategy in the FPHCP is similar to the interim water typing system in that water types are largely based on beneficial use. However, unlike the interim system that has five classes, the permanent water typing system has four classes: Type S, Type F, Type Np and Type Ns. Type S includes "shorelines of the state." Type F includes "fish habitat" waters. Type Np includes "non-fish, perennial" waters. Type Ns includes "non-fish, seasonal" waters.

These four classes are related to the five classes of the interim system in that Type S waters closely coincide with Type 1 waters, the Type F class includes both Type 2 and Type 3 waters and Type Np and Ns waters are the same as Type 4 and 5 waters, respectively. The forest practices rules direct DNR to work cooperatively with WDFW and Ecology and to consult with affected tribes when classifying streams, lakes and ponds throughout the state.

Type S waters are all waters—within their bankfull width—inventoried as "shorelines of the state," including periodically inundated areas of associated wetlands.

Type F waters are segments of natural waters other than Type S waters, within the bankfull widths of defined channels and periodically inundated areas of associated wetlands or within lakes, ponds or impoundments having a surface area of 0.5 acre or greater at seasonal low water and which in any case contain fish habitat or are diverted for domestic use, use by fish hatcheries, are located within campgrounds or serve as off-channel fish habitat.

Type Np waters are segments of natural waters within the bankfull width of defined channels that are not fish habitat, but are perennial. Perennial means waters that do not go dry at any time during a year of normal rainfall. However, Type Np waters include the intermittently dry portions of the channel below the uppermost point of perennial flow. The following characteristics help Type Np designation depending on location: (1) at least 13 acres in the western Washington coastal zone (i.e., the Sitka spruce zone as defined by Franklin and Dryness 1973), (2) at least 52 acres in other locations in western Washington, or (3) at least 300 acres in eastern Washington.

Type Ns waters are segments of natural waters within the bankfull width of defined channels that are not Type S, F or Np waters. These are seasonal, non-fish habitat waters where surface flow is not present for at least some portion of a year of normal rainfall and are not located downstream from any stream reach that is classified as Type Np water. Type Ns waters must be physically connected to Type S, F or Np waters by an aboveground channel.

1.2.3.2 FPHCP Riparian Strategy

The Riparian Strategy addresses practices affecting certain ecological functions that are important for creating, restoring, and maintaining aquatic and riparian habitats. The strategy protects these functions along typed waters by restricting forest practices activities from the most sensitive parts of riparian areas and by limiting activities in other areas. The strategy accomplishes protection within riparian management zones (RMZs) and equipment limitation zones (ELZs) for typed waters. The RMZs are areas adjacent to Type S, Type F and Type Np waters where trees are retained so that ecological functions such as large woody debris (LWD) recruitment, shade, litterfall and nutrient cycling are maintained. The ELZs apply to Type Np and Type Ns waters and are areas where equipment use is limited so that forest practices-related erosion and sedimentation are minimized. Other riparian protection measures that apply to typed waters include restrictions on salvaging down woody debris and disturbing stream banks. Some riparian requirements differ between western and eastern Washington.

1.2.3.2.1 Western Washington

Protection measures for typed waters in western Washington include establishing riparian management zones along Type S, Type F and Type Np waters. The FPHCP applies no-harvest buffers adjacent to Type Np-associated sensitive sites. The FPHCP applies ELZs along Type Np and Type Ns waters.

1.2.3.2.1.1 Type S and Type F Waters

Riparian management zones associated with Type S and Type F waters in western Washington are made up of three sub-zones: the "core zone," the "inner zone" and the "outer zone." The core zone is closest to the water, the inner zone is the middle zone and the outer zone is farthest from the water (FPHCP Figure 4.5).

Core Zone. The core zone begins at the bankfull or channel migration zone edge and is 50 feet wide. No timber harvest or road construction is allowed in the core zone except for the construction and maintenance of road crossings and the creation and use of yarding corridors in accordance with applicable rules. Any trees cut for, or damaged by, yarding corridors in the core zone must be left on-site. Any trees cut as a result of road construction to cross a stream may be removed from the site unless they are to be used as part of an LWD replacement strategy or are needed to meet stand requirements (see Inner Zone discussion below).

Inner Zone. The inner zone begins at the outside edge of the core zone, and its width depends on site class, bankfull width, and the management option selected by the landowner. Management options in the inner zone include: (1) no harvest, (2) hardwood conversion, (3) thinning from below and (4) leaving trees closest to the water. Timber harvest is allowed within the inner zone if *stand requirements* are met. Stand requirements apply to the combined core and inner zones, and are minimum values for the following parameters: (1) the number of trees per acre, (2) the basal area per acre, and (3) the proportion of conifer.

If stand requirements are met, the combined core and inner zones are capable as it grows over time of attaining a target condition known as "Desired Future Condition" (DFC). The DFC is the condition of a mature riparian forest stand as it ages through 140 years of age and is based on basal area within that stand. DFC basal area targets have been developed for five site classes in western Washington.

Growth modeling is used to determine if a particular stand will meet the DFC basal area target. Stand attribute data are collected and input to a model that "grows" the stand to 140 years of age. If, at age 140, the estimated basal area exceeds the DFC target, harvesting may occur within the inner zone in accordance with applicable rules. In these cases, only the "surplus" basal area (i.e., basal area beyond that needed to meet the DFC basal area target) may be harvested. If the DFC basal area target will not be met, no harvest is allowed within the inner zone except in cases where the landowner chooses the hardwood conversion management option.

When the combined core and inner zones for a particular riparian stand will not meet the DFC stand requirements, no harvest is allowed in the inner zone. When no harvest is permitted in the inner zone, or the landowner elects to forego harvesting in the zone, the width of the core, inner and outer zones follow the requirements in FPHCP Table 4.2.

Landowners can harvest inner zone stands not meeting stand requirements to convert a hardwood-dominated inner zone to one that is dominated by conifers. The site must meet certain minimum requirements such as evidence that the site can be successfully converted to conifer, a maximum number and size of existing conifers, and contiguous ownership upstream and downstream of the site. Even in these situations, the FPHCP limits the spatial extent of conversion and the number and type of trees that can be harvested.

Harvesting in the inner zone must be either thinning from below, or leaving trees closest to the water. Under thinning from below, harvesting focuses on retention of most co-dominant and all dominant trees in the stand. Larger trees generally provide greater ecological benefits, particularly in terms of LWD recruitment and shade. The width of the core, inner, and outer zones must follow the requirements in FPHCP Table 4.3. In addition, harvesting cannot decrease the proportion of conifers in the stand. Any harvest within 75 feet of the bankfull edge or Channel Migration Zone (CMZ) edge must meet minimum shade requirements. Following harvest, there must be at least 57 conifer trees per acre in the inner zone.

Under the harvests leaving trees closest to the water, the width of the core, inner and outer zones must follow the requirements in FPHCP Table 4.4. This option only applies to Site Class I, II, and III RMZs on streams less than or equal to 10 feet bankfull width and to Site Class I and II RMZs on streams greater than 10 feet bankfull width. In addition, inner zone harvest must meet the prescriptions described in FPHCP Table 4.3 and 4.4.

1.2.3.2.1.2 Stream Adjacent Parallel Roads

When the basal area component of the stand requirements cannot be met due to the presence of a stream-adjacent parallel road in the core and/or inner zones, two parameters must be estimated:

(1) the basal area that would have been present if the road was not occupying the space, and (2) the corresponding shortfall in the basal area component of the stand requirements.

The total basal area equivalent to the shortfall must be retained elsewhere in the inner and/or outer zones as mitigation. If the inner and/or outer zones contain insufficient trees to address the shortfall, trees within the RMZ of other Type S or Type F waters in the same harvest unit or along Type Np or Ns waters in the same harvest unit must be retained as mitigation. In cases where other in-unit RMZs are unavailable, the landowner may implement an LWD placement strategy to address the shortfall in basal area (see Board Manual Section 26 for guidelines).

Yarding Corridors in Core and Inner Zones. When yarding corridors are necessary to facilitate harvesting within RMZs, all calculations of the basal area component of the stand requirements are to be made as if the corridors were established prior to any other harvest activity. Inner zone trees cut or damaged by yarding may be removed if they represent surplus basal area. Trees cut or damaged by yarding in a unit that does not meet the DFC basal area target may not be removed from the site.

Outer Zone. The outer zone begins at the outside edge of the inner zone and—like the inner zone—its width is dependent on site class, bankfull width, and management option selected by the landowner (see Tables 4.2 through 4.4). Timber harvest is allowed in the outer zone; however, 20 riparian leave trees (trees left after harvest activity) per acre must be retained in either “dispersed” (even distribution throughout, or “clumped” (grouped around sensitive features to the extent the features are present in the outer zone). Under either leave tree strategy, retained trees must be 12 inches minimum Diameter at Breast Height (dbh).

An LWD placement strategy involves the voluntary placement of woody debris in stream channels by forest landowners. The intent of the strategy is to enhance fish habitat in streams on managed forestlands by creating incentives for landowners to place wood. Guidance for placing woody debris in streams is found in Section 26 of the Board Manual. Wood placement projects require a Hydraulic Project Approval (HPA) from WDFW and are subject to additional requirements under the State’s Hydraulic Code.

1.2.3.2.1.3 Type Np and Type Ns Waters

Protection measures for non-fish bearing waters in western Washington include the establishment of ELZs adjacent to Type Np and Type Ns waters and the establishment of RMZs adjacent to Type Np waters and associated sensitive sites. ELZs minimize ground and soil disturbance, protecting stream bank integrity and preventing sediment delivery to non-fish-bearing waters. ELZs apply to all Type Np and Type Ns waters, are 30 feet wide and are measured from the bankfull width.

To minimize equipment-based exposure of soil on more than ten percent of the surface area of the ELZ, the FPHCP includes measures such as operating ground-based equipment, constructing and using skid trails and stream crossings, and yarding partially suspended, cabled logs. Other measures to address lost function as it relates to the prevention of sediment delivery include, but are not limited to, water bars, grass seeding and mulching.

Protection of Type Np waters includes the establishment of RMZs along portions of Type Np waters and around all sensitive sites. The RMZs are either 50 or 56 feet in width (depending on the feature being protected). No harvesting is allowed within the buffer. Requirements ensure that two-sided RMZs are established along at least 50 percent of the Type Np water length. The approach targets the most ecologically sensitive parts of Type Np waters, resulting in a discontinuous network of buffers that protects areas most important to aquatic resources (Figure 4.6).

High priority areas for RMZ protection include the lower reaches of Type Np waters immediately above the confluence with Type S or Type F waters and designated sensitive sites including seeps, springs, Type Np confluences, Type Np initiation points, and alluvial fans. If RMZ establishment adjacent to these areas does not protect 50 percent of the Type Np water length, additional buffers must be left along other priority areas, including low gradient stream reaches, tailed frog habitat, groundwater influence zones and areas downstream from other buffered reaches.

The width of RMZs adjacent to sensitive sites varies according to the type of sensitive site. Headwall and side-slope seep RMZs are measured from the perennially saturated soil edge and are 50 feet wide. RMZs for Type Np confluences, headwater springs, and Type Np initiation points are measured from the center of the feature or point of confluence, are circular in shape and are 56 feet wide (i.e., have a radius of 56 feet). No-harvest RMZs along areas not designated as sensitive sites are 50 feet wide, measured from the bankfull edge. The full extent of alluvial fans, regardless of shape or size, receives no-harvest protection.

1.2.3.2.2 Eastern Washington. Protection measures for eastern Washington waters are threefold. First, measures include the establishment of riparian management zones along Type S, Type F and Type Np waters. Second, the FPHCP provides for the protection of Type Np-associated sensitive sites. Finally, the FPHCP establishes ELZs adjacent to Type Np and Type Ns waters.

<u>1.2.3.2.2.1 Type S and Type F Waters</u>

Riparian management zones associated with Type S and Type F waters in eastern Washington consist of three sub-zones; the “core” zone, the “inner” zone, and the “outer” zone.

Core Zone. The core zone is 30 feet wide, beginning at the bankfull or channel migration zone edge. No timber harvest or road construction is allowed in the core zone except for the construction and maintenance of road crossings and the creation and use of yarding corridors. Any trees cut for, or damaged by yarding corridors in the core zone must be left on-site. Any trees cut as a result of road construction to cross a stream may be removed from the site unless they are to be used as part of an on-site LWD replacement project. LWD placement projects are required in cases where a landowner wants to reduce the number of outer zone leave trees below the standard requirement (see description outer zone below).

Inner Zone. The inner zone begins at the outside edge of the core zone and its width depends on bankfull width (Tables 4.6 and 4.7). The inner zone width is 45 feet for waters with bankfull widths of 15 feet or less. For waters with bankfull widths that exceed 15 feet, the inner zone width is 70 feet. FPHCP tables 4.6 and 4.7 provide more detailed information on zone widths prescribed in the FPHCP and are incorporated here by reference.

Inner zone harvest includes leave tree retention. Leave tree requirements vary by timber habitat type. Three timber habitat types are recognized: (1) ponderosa pine, (2) mixed conifer, and (3) high elevation. The ponderosa pine timber habitat type is 2,500 feet or lower in elevation, the mixed conifer timber habitat type is 2,501 to 5,000 feet in elevation and the high elevation timber habitat type is above 5,000 feet. Inner zone leave tree requirements for each timber habitat type are described below.

Ponderosa Pine Timber Habitat Type. The FPHCP divides stands in the ponderosa pine timber habitat type into two classes: (1) stands with high basal areas, and (2) stands with low basal areas and high densities. For stands with high basal area, harvest is allowed. Harvest must retain at least 50 trees per acre and at least 60 square feet of basal area per acre must be retained following harvest. For stands with low basal area and high density, harvest is allowed. Harvests must retain at least 100 trees per acre.

To the extent down wood is available on-site prior to harvest, at least 12 tons of down wood per acre must be left following harvest. Where available, at least six pieces greater than 16 inches diameter and 20 feet in length, and four pieces greater than 6 inches diameter and 20 feet in length must be left after harvest. These requirements apply both to stands with high basal area and stands with low basal area and high density.

Mixed Conifer Timber Habitat Type. Forest practices rules divide stands in the mixed conifer timber habitat type into two classes: (1) stands with high basal areas, and (2) stands with low basal areas and high densities. Inner zone leave tree requirements differ between the two stand classes. For stands with high basal area, harvest is allowed and must retain at least 50 trees per acre at a variety of basal area requirements depending on site index. For stands with low basal area and high density, harvest is allowed in the inner zone of RMZs depending on number of existing trees and density. Following thinning, at least 120 trees per acre must be retained. To the extent down wood is available on-site prior to harvest, at least 20 tons per acre of down wood of certain sizes must be left following harvest. The FPHCP requires retention of down wood, where available.

High Elevation Timber Habitat Type. Harvesting in the inner zone of RMZs in the high elevation timber habitat type is allowed if stand requirements can be met. Stand requirements and harvest rules are the same that apply to inner zone harvest for western Washington RMZs for Type S and Type F. To the extent down wood is available on-site prior to harvest, at least 30 tons per acre of down wood of certain sizes must be left following harvest, where available.

1.2.3.2.2.2 Stream-Adjacent Parallel Roads, All Timber Habitat Types

For sites limited by roads in the inner zone, the allowable harvest is determined by the bankfull width and proximity of the road to the outer edge of the bankfull width or CMZ. No harvesting is allowed in that portion of the inner zone located between the road and water. When the edge of the road closest to the water is located within 75 feet (for waters with a bankfull width of more than 15 feet) or 50 feet (for waters with a bankfull width of less than 15 feet) of the outer edge of the bankfull width or CMZ, the FPHCP requires leave trees near streams in or adjacent to the unit to be harvested to offset those missing because of the road. Where DNR identifies leave tree limitations, the FPHCP prescribes site-specific management strategies to replace lost riparian functions. Such management strategies may include placement of LWD in streams.

Outer Zone. The outer zone begins at the outside edge of the inner zone and its width depends on site class and bankfull width (see FPHCP Tables 4.6 and 4.7). Timber harvest is allowed in the outer zone. Harvests must retain riparian leave trees depending on the timber habitat type. In the ponderosa pine timber habitat type, a minimum of 10 dominant or co-dominant trees per acre must be retained. In the mixed conifer timber habitat type, a minimum of 15 dominant or co-dominant trees per acre must be retained. Finally, requirements for high elevation timber habitat type follow those for western Washington RMZs for Type S and Type F waters.

Minimum tree counts must be met regardless of stream-adjacent parallel road presence. Outer zone leave tree requirements for eastern Washington RMZs for Type S and Type F waters may be reduced to five trees per acre in the ponderosa pine timber habitat type, eight trees per acre in the mixed conifer timber habitat type and 10 trees per acre in the high elevation timber habitat type if the landowner implements a LWD placement plan consistent with guidance contained in Board Manual Section 26.

1.2.3.2.2.3 Type Np and Type Ns Waters

As in western Washington, the FPHCP protection measures for non-fish-bearing waters in eastern Washington include ELZs adjacent to Type Np and Type Ns waters, RMZs adjacent to Type Np waters, and mitigating the effects of stream-adjacent parallel roads within RMZs of Type Np waters. ELZs would apply to all Type Np and Type Ns waters, are 30 feet wide and are measured from the bankfull width. As for ELZs in western Washington, operations exposing soil on more than 10 percent of a site in an ELZ requires mitigation. Mitigation will include replacing the equivalent lost riparian function, particularly as it relates to the prevention of sediment delivery. Example measures include—but are not limited to—water bars, grass seeding and mulching.

Riparian Management Zones for Type Np waters in eastern Washington consist of 50-foot wide RMZs on each side of the water. The FPHCP does not prescribe management strategies (i.e. partial or clearcutting) within these RMZs. For partial cuts, the FPHCP requires the same minimum basal area requirements as it does for Type S and Type F waters. The basal area requirement must be met regardless of stream-adjacent parallel road presence. For clearcut management, the FPHCP requires a 50-foot wide RMZ along each side of a stream reach in the harvest unit. No harvest will be allowed within the RMZ. The RMZ must be equal in total length to the clearcut portion of the stream reach in the harvest unit. It also must meet the upper end of the basal area requirement for the RMZ inner zone for Type S and Type F waters in the corresponding timber habitat type.

Stream-Adjacent Parallel Roads within Type Np Riparian Management. For sites limited by stream-adjacent parallel roads in the inner zone of an RMZ, the proximity of the road to the outer edge of the bankfull width determines the allowable harvest. If the edge of the road closest to the water is between 30 feet and 49 feet from the outer edge of the bankfull width, a 50-foot wide RMZ on each side of the stream must be retained. If harvest is occurring on only one side of the water, a 50-foot wide RMZ must be retained that does not include the width of the stream-adjacent parallel road. If the edge of the road closest to the water is less than 30 feet from the outer edge of the bankfull width, all trees between the water and the edge of the road closest to the water must also be retained.

1.2.3.3 Twenty-Acre Parcels Eligible for Alternative Measures

State law makes special provisions for parcels that are 20 contiguous acres or less, and are owned by individuals whose total ownership is less than 80 forested acres statewide. These parcels are not subject to certain FPHCP riparian requirements. Forestry activities on these exempt parcels are covered by the proposed ITP and the effects of operations under the provisions for exempt parcels are described below. State law requires RMZs for Type S and Type F waters on exempt parcels. The RMZ width cannot be less than 29 feet or more than the maximum widths listed in FPHCP Table 4.4. When the RMZ overlaps a Type A or B wetland or wetland management zone (see Section 4d), the measure that best protects public resources must be applied.

Leave tree requirements for Type S and Type F waters on eligible 20-acre parcels in western Washington are listed in FPHCP Table 4.5. The required ratio of conifer to deciduous leave trees—and the number and minimum diameters of leave trees—varies with water type and bankfull width. The number of leave trees also differs between gravel/cobble-bedded waters and boulder/bedrock waters.

Along Type Np waters, DNR can require tree retention on eligible 20-acre parcels where necessary to protect public resources. Forest practices rules authorize DNR to require the retention of 29 trees, at least six inches dbh, on each side of every 1,000 feet of stream length within 29 feet of the stream. More information on riparian protection on eligible 20-acre parcels in western Washington is contained in WAC 222-30-023(1).

In eastern Washington, RMZs for Type S and Type F waters in eligible parcels cannot be less than 35 feet or more than 58 feet (for partial cuts) or 345 feet (for other harvest types). Leave tree requirements apply to these zones. When the RMZ overlaps a Type A or B wetland or wetland management zone (summarized below), the measure that best protects public resources must be applied.

Along Type Np waters in eastern Washington, DNR can require tree retention on eligible 20-acre parcels where necessary to protect public resources. Forest practices rules authorize DNR to require the retention of 29 trees of at least six inches dbh on each side of every 1,000 feet of stream length within 29 feet of the stream.

For this consultation, NMFS assumed that only certain parcels presently eligible for the 20-acre exempt provisions would be harvested according to those provisions. To identify those parcels, NMFS described three criteria for inclusion of parcels as eligible for the "20-acre exemption" provision of the FPHCP. These criteria are based on permit conditions in the proposed ITP, generally referred to in this consultation as the "grandfathering" provisions. The development of the conditions on which these assumptions are based was to avoid the risk subdivision of larger, ineligible ownerships to enable forestry operations under the exempt provisions. The grandfathering criteria are:

1. Existing qualifying forest lands (in parcels of 20 acres or less) owned or purchased by a person who provides evidence of qualifying as an eligible person (owns no more than 80 forested acres in Washington) as of and since the date of permit issuance.

2. Existing qualifying forest lands which continued to be qualified since the date of permit issuance when purchased, inherited, or otherwise lawfully obtained by a person who is qualified at the time they take possession of such lands.

3. New forest land (converted from another land use) owned by a person qualified at the time of the conversion to forest land and who continues to be qualified (sometimes referred to as "aforestation"). New forest lands which qualify under this provision may also be transferred according to item b above.

During the development of the FPHCP, the subsequent NEPA process, and this consultation, the provisions of the FPHCP addressing forestry practices on 20-acre exempt parcels were highly scrutinized and discussed amongst the Services, Applicant, Tribes, Forest and Fish collaborators and stakeholder, and the public. The two topics most frequently discussed with respect to these provisions were 1) land-use conversions from forestry by small landowners, and 2) whether landscape level analysis could accurately capture the effects of forestry activities under the provisions themselves. Land-use conversions are not covered by the HCP and the converters would not be covered for the incidental take caused by their conversion activities. Therefore, the first issue is outside the scope of this consultation and not considered in the effects analysis below. In contrast, the second issue remained controversial and the Services strongly considered the concerns expressed, partaking in both a Government-to-Government meeting with the Tribes on April 21, 2006, and a meeting with the Applicant and collaborators (including the association representing small forest landowners) on April 27, 2006.

Emerging from the consultation process, the Services developed a method for ensuring that any deficit in habitat function resulting from the difference in operations under the 20-acre exempt practices (summarized below) would be adequately minimized. The Services developed permit conditions for their respective ITPs that would limit the extent of forest practices under the FPHCP eligible 20-acre exempt provisions to no more than 10 percent less LWD function (than provided under the ordinary FPHCP riparian provisions) in any given Watershed Administrative Unit (WAU). In turn, no more than 15 percent of the stream length within any given Watershed Resource Inventory Area (a combination of one or more WAUs) could hit the 10 percent limit for the difference in extent of function.

The Applicant would implement the proposed limit through the process of monitoring Forest

Practices Approvals (FPA) for eligible landowners, enabling the Applicant to determine when the limits are reached for any given WAU and the Water Resource Inventory Areas (WRIAs) in which the WAUs are drawn. These provisions, combined with the risk averse measures of grandfathering only presently eligible parcels and providing no incidental take coverage for land-use converters, are to ensure against concentration of FPAs for eligible parcels in any way that might depart from the analysis presented in the EIS and in this consultation of the effects of forest practices under the 20-acre exempt provisions.

Limits on the applicability of the exempt forest practices provisions were derived to minimize the accumulated effects of harvest under the exempt provisions, relative to the standard FHPCP riparian prescriptions. To assess and limit such accumulation, the Services and stakeholders decided on the WAU, a geographic unit described for the State's watershed analysis process, as the smallest geographic scale at which accumulated effects could be discerned or measured (Matthew Longenbaugh, pers. comm.). The State's watershed analysis process is concerned with accumulated effects in two ways: 1) the accumulated results of many small, even insignificant activities at a site, and 2) changes in dominant watershed processes triggered by spatially limited activity at a "sensitive site" (WFPB 1997). For the proposed action's provisions covering harvest on 20-acre exempt parcels, the Services and other Forest and Fish stakeholders and Tribes were particularly concerned about the former. Therefore, the ITP conditions limiting extent of permissible functional difference was developed to be applied at the WAU scale, with a further limitation of the spatial extent of application at the WRIA scale.

1.2.3.4 Statewide Requirements

In addition to the riparian protection measures that are specific to western and eastern Washington, forest practices rules include riparian requirements that apply throughout the state, including to eligible 20-acre parcels. These include requirements for the retention of shade along Type S and Type F waters, restrictions on the salvage of down trees and woody debris and requirements for the maintenance of stream bank stability. Each set of protection measures is described below.

Shade Retention. Shade requirements differ for forestlands within the Bull Trout Overlay (BTO) and lands outside the BTO. The BTO includes portions of eastern Washington streams containing bull trout habitat as identified on FPHCP Figure 4.7. Within the BTO, all available shade must be retained within 75 feet of the bankfull edge or channel migration zone edge, whichever is greater. Outside of the Bull Trout Overlay, a temperature prediction method must be used to determine shade requirements. The temperature prediction method is used to establish the shade level necessary to meet the temperature standard. If pre-harvest shade levels do not meet the shade requirement, no harvest is allowed within 75 feet of the bankfull edge or CMZ edge. If pre-harvest shade levels exceed the shade requirement, harvest in the RMZ inner zone is allowed provided that shade levels are not reduced below the minimum required and that all other applicable rules are met.

Salvage Logging. Forest practices rules protect ecological functions and associated habitats by restricting salvage of down wood in typed waters, CMZs, and RMZs. Salvage logging is not allowed within the bankfull width of any typed water or within a channel migration zone, including salvage logging of any portion of a tree that may have fallen outside the zone. Salvage logging within an RMZ for a Type S or Type F water is based on the sub-zone (core, inner and outer zones) from which the tree originated, applicable stand requirements and extent of previous harvest activity in the zone (FPHCP Table 4.8). Salvage logging is not allowed within an RMZ for a Type Np water or associated sensitive site, but may occur adjacent to Type Ns waters.

Streambank Integrity. Activities in the RMZ core zone for Type S and Type F waters and in RMZs for Type Np waters must ensure stream bank integrity is maintained. Activities must avoid disturbing stumps, root systems and any logs embedded in the stream bank, as well as brush and other similar understory vegetation. Where necessary, high stumps must be left to prevent felled and bucked timber from entering the water. Trees with large root systems embedded in the stream bank must also be left.

1.2.3.5 FPHCP Wetland Protection Strategy

The FPHCP includes measures to avoid, minimize, and mitigate forest practices-related impacts to wetland habitats. Measures are intended to protect important ecological functions such as LWD recruitment, shade retention, sediment filtration and the maintenance of surface and shallow subsurface hydrology. Protection measures include a wetland typing system, wetland management zones (WMZs) adjacent to Type A and Type B wetlands, and the use of low-impact harvest systems in forested wetlands. Wetland protection measures are the same statewide.

Wetland Typing System. The FPHCP covers two broad categories of wetlands: forested and non-forested. Forested wetlands include any wetland or portion thereof that has—or if the trees present were mature would have—at least 30 percent canopy closure. Non-forested wetlands include any wetland or portion thereof that has—or if the trees present were mature, would have—less than 30 percent canopy closure. Non-forested wetlands are classified as either Type A or Type B. Type A wetlands include all non-forested wetlands greater than 0.5 acre in size, including any acreage of open water where the water is completely surrounded by the wetland, and are associated with at least 0.5 acre of ponded or standing open water. The open water must be present on the site for at least seven consecutive days between April 1 and October 1, or are bogs greater than 0.25 acre in size. Type B wetlands include all other non-forested wetlands greater than 0.25 acre in size.

Protection Measures for Forested Wetlands. The FPHCP allows harvest in forested wetlands. Harvest is limited to low-impact harvest systems to minimize effects on soils and hydrology. Low-impact harvest systems generally include ground-based equipment with tracks (e.g., shovel), cable yarding machines, helicopters and balloons. Also, when yarding logs, operators must keep at least one end of the log suspended when feasible.

When forested wetlands lie within a proposed harvest unit, landowners are encouraged to leave 30 to 70 percent of required wildlife reserve trees within the wetland. Wildlife reserve trees are defective, dead, damaged or dying trees that provide or have the potential to provide habitat for wildlife species dependent on standing trees. In western Washington, forest practices rules require the retention of three wildlife reserve trees and two green recruitment trees (i.e., trees left for the purpose of becoming future wildlife reserve trees) for each acre harvested. In eastern Washington, two wildlife reserve trees and two green recruitment trees must be retained for each acre harvested.

Protection Measures for Non-Forested Wetlands. Protection measures for Type A and Type B non-forested wetlands include limitations on harvesting in the wetlands. Harvest is not allowed in a Type A wetland that meets the definition of a bog. Individual trees or forested wetlands less than 0.5 acre in size that occur within a non-forested wetland, must be retained. They may be counted toward the WMZ leave tree requirement (see below). Harvest of upland areas or forested wetlands surrounded by a Type A or Type B wetland must be conducted in accordance with a plan that has been approved by DNR in writing. No trees can be felled into or yarded across a Type A or Type B wetland without written approval from DNR.

Non-forested wetlands are also protected through wetland management zones. WMZs must be established adjacent to all Type A and B wetlands. They are measured horizontally from the wetland edge or the point where the non-forested wetland becomes a forested wetland (see Board Manual Section 8 for delineation procedures). The required WMZ width depends on the wetland type and size (FPHCP Table 4.9). The average WMZ width must meet the requirement listed in FPHCP Table 4.9. To meet the average width, it can vary from the minimum width to the maximum width listed in FPHCP Table 4.9. When a WMZ overlaps an RMZ, the requirement that best protects public resources must be applied.

Harvest is allowed within WMZs according to several conditions. At least 75 trees per acre must be retained. Wildlife reserve trees should be located within the WMZ where feasible. Partial cutting or removal of groups of trees within the WMZ is acceptable. Tractors, wheeled skidders, or other ground-based harvest equipment is not allowed within the minimum WMZ width without written approval from DNR. And finally, when at least ten percent of a harvest unit lies within a WMZ, at least 50 percent of the 75 trees-per-acre requirement must be retained within that WMZ.

1.2.3.6 Protective Approaches in Logging Practices

The FPHCP includes protection measures that regulate the methods of harvest in riparian and wetland areas. Measures include limits on the felling and bucking of timber, on the use of ground-based equipment, and on cable yarding. Many of these measures are designed to minimize soil disturbance and reduce the potential for erosion and sedimentation and maintain other ecological functions as described below.

Felling and Bucking. Felling trees and bucking logs (cutting felled trees to length) in or adjacent to typed waters and RMZs must be conducted in a manner that protects riparian and in-stream habitat and water quality. Limitations on felling include no felling into the RMZ core zone of Type S or Type F waters, sensitive sites, or Type A or Type B wetlands. There is a limited exception for safety. Within the RMZ inner and outer zones of Type S and Type F waters, and within wetland management zones, felling must facilitates yarding away from typed waters. Trees may be felled into Type Np waters, but logs must be removed as soon as practical. Slash introduced to the Type Np water as a result of the falling must be removed. Reasonable care must be taken to fall trees in directions that minimize damage to residual trees. Bucking or limbing of any portion of a tree lying within the bankfull width of a Type S, Type F or Type Np water; in the core zone of RMZs, in sensitive sites, or in open water areas of Type A or Type B wetlands is not allowed.

Ground-based Equipment. Ground-based equipment use is prescribed to limit direct physical impacts to waters and wetlands and to minimize indirect impacts such as soil disturbance and associated erosion and sedimentation. Ground-based equipment is not allowed in Type S or Type F waters except with approval by DNR and with an HPA issued by WDFW. Ground-based transport of logs across Type Np and Type Ns waters must minimize the potential for damage to public resources. For Type A and Type B wetlands, the FPHCP ground-based equipment is not allowed. Where harvest occurs in non-forested wetlands, ground-based logging is limited to low impact harvest systems. Ground-based equipment operating in wetlands is only allowed during periods of low soil moisture or frozen soil conditions.

In RMZs, use of ground-based equipment within an RMZ must be approved in writing by DNR. When yarding logs in or through an RMZ with ground-based equipment, the number of routes through the zone must be minimized. Logs must be yarded to minimize damage to leave trees and vegetation in the RMZ.

In WMZs, ground-based equipment is not allowed within the minimum WMZ width unless approved in writing by DNR. Where feasible, logs must be skidded with at least one end suspended from the ground to minimize soil disturbance and damage to leave trees and vegetation in the WMZ.

Finally, skid trails must be sized, shaped, and located to minimize the contribution to overland sediment transport, through erosion and other means. Placement of sidecast material is limited to above the 100-year flood level. Skid trails running parallel or near parallel to waters must be located outside the no-harvest portions of RMZs and at least 30 feet from the bankfull edge of unbuffered portions of Type Np or Ns waters, unless approved in writing by DNR. Skid trails must cross the drainage point of swales at an angle that minimizes the potential for delivering sediment to typed waters or where channelization is likely to occur. Skid trails out of use must be water-barred to prevent soil erosion. Skid trails located within 200 feet of any typed water that directly delivers to the stream network must have water bars, grade breaks and/or slash to minimize sediment delivery to the water. Water bars must be placed at a frequency that minimizes gullying and soil erosion. In addition to water barring, skid trails with exposed, erodible soil that may be reasonably expected to cause damage to a public resource must be seeded with a non-invasive plant species (preferably native to the state) and adapted for rapid revegetation of disturbed soil, or be treated with other erosion control measures acceptable to DNR.

Cable Yarding. No cable yarding in or across Type S or Type F waters, except where logs will not materially damage the bed of waters, banks of sensitive sites or riparian management zones. Yarding corridors through RMZ of a Type S or Type F water must be no wider or more numerous than necessary to accommodate safe and efficient transport of logs. Generally, yarding corridors should be located at least 150 feet apart (measured edge to edge), and each should be no wider than 30 feet. Total openings resulting from yarding corridors must not exceed 20 percent of the stream length associated with the forest practices application. When changing cable locations, care must be taken to move cables around or clear of the riparian vegetation to avoid damaging it. In Type A and Type B wetlands, cable yarding is not allowed without written approval from DNR.

Yarding from or across FPHCP protected areas requires reasonable care to minimize damage to the vegetation that provides shade to the water, and to minimize disturbance to understory vegetation, stumps and root systems. Uphill yarding is preferred. Where downhill yarding is used, reasonable care must be taken to lift the leading end of the log to minimize downhill movement of slash and soils. When yarding parallel to a Type S or Type F water, and below the 100-year flood level or within the riparian management zone, reasonable care must be taken to minimize soil disturbance and to prevent logs from rolling into the water or riparian management zone.

1.2.3.7 Other Programs for Riparian Protection

The FPHCP includes two programs that provide for the long-term conservation of riparian and aquatic habitats. The Forestry Riparian Easement Program (FREP) and the Riparian Open Space Program (ROSP) were established to acquire, through purchase or easement, the most ecologically important habitats for species covered under the FPHCP. Unlike most FPHCP protection measures, the FREP and ROSP are voluntary programs that complement the mandatory requirements of the Act and rules. As part of the complete set of protection measures, these voluntary programs will help ensure that the Forest Practices program meets its goals, resource objectives and performance targets.

Forest Riparian Easement Program. FREP provides long-term protection for aquatic resources by acquiring easements from small forest landowners in riparian areas and other ecologically important areas. Easement areas typically include channel migration zones, riparian management zones and wetland management zones, but may also include other areas, such as unstable slopes. Landowners interested in participating in FREP must meet the definition of a "small forest landowner," which is related to his/her prior three-year average harvest level. FREP easements apply to "qualifying timber" and not the land on which the trees grow. "Qualifying timber" is trees that are covered by a forest practices application and that the small forest landowner is required to leave unharvested.

Riparian Open Space Program. The ROSP ensures the long-term conservation of aquatic resources by acquiring a fee interest in, or easement on, lands and timber within a specific type of channel migration zone known as an "unconfined avulsing CMZ." These areas typically have very high ecological value as spawning and rearing habitat for salmon and other fish species. No timber harvesting or road construction may occur within CMZs due to their ecological importance.

Upland Protection and Roads. The FPHCP Upland Strategy consists of protection measures that are implemented in upslope areas outside riparian zones and wetlands. These measures are intended to limit forest practices-related changes in physical watershed processes—such as erosion and hydrology—that may adversely affect the quality and quantity of riparian and aquatic habitat lower in the watershed. The goal of the Upland Strategy is to prevent, avoid, minimize, or mitigate forest practices-related changes in erosion and hydrologic processes and the associated effects on public resources. Specific objectives of the Upland Strategy include preventing forest practices-related landslides, addressing the affects of forest roads on fish passage at all life stages, limiting sediment delivery to all typed waters, surface water and other hydrologic management, woody debris passage, protecting stream bank stability, minimize the construction of new roads, and ensure that there is no net loss of wetland function.

1.2.3.8 Unstable Slopes

Protection measures related to unstable slopes and landforms are outcome-based, rather than prescriptive. Measures are derived through a process in which DNR evaluates proposed timber harvest and construction activities on unstable slopes to determine if the activities will have a "probable significant adverse impact." The only exception to this outcome-based, decision-making process occurs in areas where watershed analysis has been conducted and approved, management prescriptions are in place to address unstable slopes, and the prescriptions are specific to the site or situation and do not call for additional analysis.

The FPHCP recognizes four classes of unstable slopes. These four are: (1) landforms typically associated with debris avalanches, flows, and torrents (inner gorges, bedrock hollows, and convergent headwalls with slopes greater than 35 degrees (70 percent)); (2) landforms susceptible to debris avalanches (toes of deep-seated landslides with slopes greater than 33 degrees (65 percent) and the outer edges of meander bends along valley walls or high terraces of unconfined meandering channels); (3) groundwater recharge areas of deep-seated landslides in glacial sediments; and (4) areas with indicators of potential slope instability that cumulatively indicate the presence of unstable slopes.

The FPHCP summarizes the process through which unstable slopes are identified in forest practices applications, deriving the management practices for each slope. When unstable slopes are identified, the application must include an expert geotechnical assessment. DNR staff also evaluates proposals involving unstable slopes.

After review, DNR issues a decision under SEPA considering several issues. The first is if the proposal is likely to increase the probability of mass movement on or near the site. The second issue is whether sediment or debris would be delivered to a public resource or be delivered in a manner that would threaten public safety. Finally, the DNR will consider whether such movement and delivery are likely to cause significant adverse impacts.

If DNR determines the effects are likely to be significant under SEPA, the DNR will accord mitigation measures. These will range from avoiding unstable slopes to altering the methods or techniques used in timber harvest and/or construction operations. Unstable slopes avoidance is the most commonly used mitigation measure and results in the lowest hazard and risk. Where timber harvest and/or construction activities occur on unstable slopes, a variety of mitigation measures are employed to reduce the likelihood of mass wasting. Harvest-related mitigation measures typically include minimum stand density requirements to maintain rooting strength and slope hydrology, and full suspension log yarding to reduce soil disturbance and damage to residual vegetation. Construction-related mitigation measures often relate to the design and/or location of roads and landings. Full-bench end-haul (i.e., no fill or sidecast material) construction techniques are routinely required on unstable slopes. Where fill material is necessary, the use of quarried rock rather than “native” soil or fill is often required to increase the structural strength of road prisms and stream crossings. These are just a few examples of the many mitigation measures used to address unstable slopes issues. The measures used in a given situation are dependent upon the nature of the impact being mitigated.

1.2.3.9 Forest Roads

The FPHCP presents rules designed to minimize negative road impacts through the proper location, design, construction, maintenance and abandonment of forest roads.

Location and Design. Roads must fit to the topography to minimize alteration of natural features. This includes avoiding at-risk areas such as surface waters, wetlands, channel migration zones, riparian management zones, sensitive sites and equipment limitation zones. The FPHCP prohibits new road construction that would lead to duplicative or unnecessary roads. Design standards are mainly related to construction techniques and water management. The FPHCP encourages road designs that utilize balanced cut-and-fill construction to avoid side-casting of excess fill material. In steep terrain (greater than 60 percent slopes), the FPHCP requires “full-bench” designs in which no fill material is used to construct the road prism and waste material is end-hauled or over-hauled to stable locations. Water management requirements focus on maintaining hydrologic flowpaths and minimizing sediment delivery by limiting road-induced rerouting of water. Forest practices under the FPHCP include design standards for culvert sizing and drainage structure spacing. Rules also require that roads be designed so that ditch water is relieved onto the forest floor to facilitate infiltration and minimize sediment delivery.

Construction. Road construction requirements focus on maintaining stable road prisms and water crossing structures, and on minimizing sediment delivery to surface waters and wetlands. The requirements are also intended to limit impacts to habitat during the construction process. New roads must maintain stable, intact prisms and water crossing structures to control erosion and sediment delivery. Road prism-related measures include limiting the volume of organic matter that can be incorporated into the road prism, compacting fills, removing construction-related debris and slash from culvert inlets, installing ditches and drainage structures concurrent with construction, depositing waste materials in stable locations and preventing side-casting of excess fill material on steep slopes. Measures that focus on maintaining the stability of water crossing structures require the installation of structures that pass the 100-year flow, the construction of fills and embankments to withstand the 100-year flow, and the construction of headwalls and catch basins to accommodate the 100-year flow.

Road construction measures in the FPHCP are designed to minimize sediment delivery from roads during and after construction. Requirements include limiting construction to periods of low soil moisture, end-hauling or over-hauling of waste material when side-casting would deposit sediment in areas where delivery to waters or wetlands may occur, sloping roads and landings to prevent water accumulation, and stabilizing exposed soils by seeding or other techniques approved by DNR. If DNR determines that the installation of a water crossing structure would result in unacceptable water quality impacts, the agency may require flow diversion around the site during construction.

Construction must also minimize impacts to riparian and in-stream habitats. The channel bed, stream banks, and riparian vegetation disturbance will be minimized. Disturbed areas must be stabilized and restored according to established schedules and procedures.

Maintenance and Abandonment. The FPHCP includes a road maintenance and abandonment program to prevent sediment- and hydrology-related impacts to public resources. Forest landowners must operate according to Road Maintenance and Abandonment Plans (RMAP) for roads within their ownership. Planning requirements differ for small and large forest landowners.

Large Landowners. The FPHCP requires large forest landowners to prioritize road maintenance and abandonment planning based on a "worst first" principle. Prioritization criteria include: (1) the presence of Federal or state listed threatened or endangered fish species or 303(d) listed water bodies, (2) the presence of sensitive geologic formations with a history of mass wasting, (3) the presence of planned or ongoing restoration projects, and (4) the presence of roads likely to have high future forest practices use. Within each RMAP, maintenance and abandonment work is also prioritized: (1) removing fish blockages, (2) preventing or limiting sediment delivery, (3) disconnecting the road and stream networks, (4) repairing or maintaining stream-adjacent parallel roads, (5) restoring hydrologic flow paths, and (6) capitalizing on operational efficiencies.

Small Landowners. Small forest landowners have two options for meeting road maintenance and abandonment planning requirements. Small forest landowners may follow the RMAP process for large landowners described above, or they may submit a "checklist" RMAP with each forest practices application or notification. Where watershed analysis has been conducted and approved, small forest landowners may elect to follow the watershed administrative unit-road maintenance plan rather than working under an RMAP. The smallest landowners (individual ownership of less than 80 acres of forestland in Washington and an application to operate on 20 acres or less) are not required to submit an RMAP or checklist RMAP for that parcel.

RMAP Implementation. Road maintenance and abandonment work carried out under a DNR-approved RMAP must: (1) keep drainage structures functional, (2) divert captured groundwater from ditchlines onto stable portions of the forest floor, (3) maintain road surfaces to minimize erosion and delivery of water and sediment to typed waters, and (4) slope or waterbar road surfaces to prevent water accumulation. When abandoning roads, landowners must slope or waterbar roads to minimize erosion and maintain drainage, leave ditches in a condition that minimizes erosion, block roads so that four-wheel highway vehicles cannot pass the point of closure, and remove water crossing structures and fills.

1.2.3.10 Practices Addressing Rain on Snow Conditions

The FPHCP addresses road-induced changes in hydrology by establishing standards for road construction, maintenance, and abandonment in areas affected by snowmelt. Forest practices rules address rain-on-snow effects in two ways in areas that have either undergone Watershed Analysis or have not. Watershed analysis in Washington State includes an assessment of timber harvest-induced changes in rain-on-snow generated peak flows and potential impacts to fish habitat, water quality and public capital improvements. Specific management prescriptions are developed to address rain-on-snow effects in parts of the Watershed Analysis Unit (WAU) where significant hydrologic change is likely to occur and resources are sensitive to those changes. Prescriptions typically involve limits on clearcut harvesting.

Where watershed analysis has not been performed, a forest practices rule commonly known as the "rain-on-snow rule" gives DNR authority to set conditions on permits for forest practices applications and notifications that propose clearcut harvesting in the significant rain-on-snow zone. Under the rain-on-snow rule, DNR may limit clearcut size when it determines that peak flows have caused material damage to public resources including water, fish, wildlife and public capital improvements. DNR has prepared conditioning guidelines for implementing the rain-on-snow rule (FPHCP Appendix M). The guidelines describe the process for evaluating forest practices applications and notifications, and rely on a risk-based approach when conditioning clearcut size. Maximum clearcut size decreases as the risk of ROS effects increases. The guidelines direct applicants and DNR to consider alternatives to clearcutting in high-risk situations.

1.2.3.11 Administrative Framework within the FPHCP

The FPHCP administrative framework is the structure within which program participants work cooperatively to develop, implement, and refine the Forest Practices program over time. The four administrative components are: (1) program participants, (2) program development, (3) program implementation, and (4) adaptive management. The first three components are briefly summarized below. The Opinion focuses more narrowly on the adaptive management element of the administrative framework as this is the element most likely to affect the species covered by the proposed FPHCP.

Participants in the Forest Practices program include the Forest Practices Board, certain programs within the DNR, the Forest Practices Appeals Board, cooperating agencies, tribes, other natural resource organizations and the general public. These entities do the work of the program. They develop, implement and refine the Forest Practices program to help it meet its goals.

Program development includes the processes by which forest practices rules, Board Manual guidelines, internal policies and technology-based tools are created. Forest practices activities carried out on covered lands must adhere to the forest practices rules; therefore, the rules represent the habitat protection measures for covered species. Board Manual guidelines, DNR internal policies and technology-based tools supplement the protection measures by providing DNR staff, forest landowners and cooperating agencies and organizations with additional direction and information related to rule implementation.

Forest Practices program implementation follows program development. Once new or revised forest practices rules, Board Manual guidelines, internal policies and technology-based tools have been developed, DNR works with those program participants affected by the change to implement the new program components. This typically includes forest landowners who must comply with provisions of the Forest Practices Act and rules, and cooperating agencies and organizations that support DNR in program implementation.

1.2.3.11.1 Adaptive Management and Program Refinement. The FPHCP includes a formal, structured Adaptive Management (AM) program that includes each of these components. The Services define adaptive management as a method for examining alternative strategies for meeting measurable biological goals and objectives and then, if necessary, adjusting future conservation management actions according to what is learned. The Services require an adaptive management strategy for habitat conservation plans that pose a significant risk to covered species at the time an ITP is issued due to significant data or information gaps. The adaptive management strategy should: (1) identify the uncertainty and the questions that need to be addressed to resolve the uncertainty; (2) develop alternative strategies and determine which experimental strategies to implement; (3) integrate a monitoring program that is capable of detecting the necessary information for strategy evaluation; and (4) incorporate feedback loops that link implementation and monitoring to a decision-making process that results in appropriate changes in management. The FPHCP adaptive management approach follows the Services definition and requirements. The AM program—like the broader Forest Practices program—consists of multiple components, each of which has a specific role in the adaptive management process. The following sections describe the AM program components, the process by which adaptive management occurs and the research and monitoring programs currently underway.

Components of the Adaptive Management Program. The primary components of the Adaptive Management program include the Board, Forest and Fish policy group (FF Policy), the Cooperative Research and Monitoring (CMER) Committee, the Adaptive Management Program Administrator (AMPA), and the Scientific Review Committee (SRC). The Forest Practices Board manages the Adaptive Management program. The Board approves CMER Committee members, establishes key research and monitoring questions and resource objectives, approves research and monitoring priorities and projects, approves CMER Committee budgets and expenditures, oversees fiscal and performance audits of the CMER Committee, participates in the dispute resolution process and considers recommendations from FF Policy for adjusting forest practices rules and guidance.

The FF Policy makes recommendations to the Board regarding CMER Committee priorities and projects, final project reports and forest practices rule and/or guidance amendments. The FF Policy membership is self-selecting and generally includes the state departments of Natural Resources, Fish and Wildlife and Ecology, Federal agencies (including NMFS, USFWS, EPA and the USDA Forest Service (USFS)), forest landowners, tribes, local governments, environmental interests and the Governor’s office.

The CMER Committee oversees and conducts research and monitoring related to Forest Practices program goals, resource objectives and performance targets. Its purpose is to advance the science needed to support the adaptive management process. The committee is charged with developing and managing, as appropriate: (1) scientific advisory groups and sub-groups, (2) research and monitoring programs, (3) a set of protocols to define and guide the execution of the process, (4) a baseline dataset used to monitor change, and (5) a process for policy approval of research and monitoring projects and use of external information.

The CMER Committee is composed of individuals who have expertise in scientific disciplines to address forestry, fish, wildlife and landscape process issues, including mass wasting, hydrology and fluvial geomorphology. Membership is approved by the Board and is open to the state departments of Natural Resources, Fish and Wildlife and Ecology, Federal agencies (including NMFS, USFWS and EPA), forest landowners, tribes, local governments and environmental interests.

The AMPA is a full-time employee of DNR and is responsible for overseeing the AM program and for supporting the CMER Committee. The AMPA makes regular reports to FF Policy and the Board on program and project priorities, status and expenditures. The AMPA has credentials as a program manager, scientist and researcher.

The Scientific Review Committee is contracted by CMER to carry out an independent peer review process to determine if work performed by the CMER Committee is scientifically sound and technically reliable. The SRC is comprised of individuals who have experience in scientific research and who have no affiliation with the CMER Committee. SRC members are selected by the SRC coordinator and can be nominated by the CMER Committee. The CMER Committee determines what products should be subject to review by the SRC. However, the SRC generally reviews final reports of CMER Committee studies, study proposals, final study plans, certain CMER Committee recommendations and pertinent studies not published in a CMER Committee-approved, peer-reviewed journal. Other products that may require review include external information or data, work plans, requests for proposal and progress reports.

Research and Monitoring in Adaptive Management. The CMER Committee produces an annual work plan that describes the various adaptive management research and monitoring programs, associated projects and work schedule. The plan will include several types of monitoring including Extensive and Intensive Monitoring, and Effectiveness and Validation Monitoring. Effectiveness monitoring is designed to evaluate the degree to which forest practices rules and guidance meet performance targets and resource objectives. Validation monitoring will determine if the performance targets are appropriate for meeting the stated resource objectives. Effectiveness and validation monitoring are conducted at a site scale and generally focus on specific rule prescriptions or practices.

"Extensive" monitoring evaluates the statewide status and trends of key watershed processes and habitat conditions across lands covered under the FPHCP. Extensive monitoring is a landscape-scale assessment of the effectiveness of forest practices rules to attain specific performance targets. This is different from effectiveness monitoring, which evaluates the effect of specific prescriptions or practices at the site scale. Extensive monitoring is designed to provide periodic measures of rule effectiveness that can be used in the AM process to determine if progress is consistent with expectations. For example, extensive monitoring might address the question, "are higher than expected stream temperatures on covered lands decreasing with time and, if so, at what rate is the reduction occurring?"

"Intensive" monitoring is a watershed-scale research program designed to evaluate cumulative effects and provide information that will improve our understanding of the interactions between forest practices and covered resources. An evaluation of cumulative effects at a watershed scale requires an understanding of how individual actions or practices influence a site and how the associated responses propagate downstream through the system. This understanding will enable the evaluation of the effectiveness of forest practices applied at multiple locations over time. Evaluating biological responses is similar and requires an understanding of how various actions interact to affect habitat conditions, and how system biology responds to habitat changes.

The FPHCP includes so-called "rule implementation tools" that are projects designed to develop, refine or validate protocols, models, and targets used to facilitate forest practices rule implementation. Two types of rule tool projects have been identified. First, Methodological Projects involve the development, testing or refinement of field protocols and models used in the identification and location of important landscape features such as water type breaks, unstable slopes and sensitive sites. Current projects focus on developing a Geographic Information System-based water typing model and a statewide landslide hazard screen. Second, Target Verification Projects are designed to assess the validity of performance targets thought to have an uncertain scientific foundation, such as the DFC basal area targets for riparian management zones.

1.2.4 Action Area

'Action area' means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For purposes of this consultation, the action area includes all of the approximately 9.3 million acres of non-Federal, non-tribal forestland and lower watershed nonforested land included as covered lands under the FPHCP; approximately 6.1 million acres of which are located west of the crest of the Cascade Range, and approximately 3 million acres are east of the crest of the Cascade Range in Washington. This acreage excludes all forestlands covered under existing, currently permitted HCPs with two exceptions. One is the Boise Cascade single-species HCP that encompasses 620 acres and provides coverage for the northern spotted owl (*Strix occidentalis*), but does not include coverage for aquatic species. The other is approximately 228,000 acres of the Washington Department of Natural Resources State Lands HCP on the eastside of the Cascade crest of Washington. This HCP provides coverage for terrestrial species in this area, but does not include coverage for aquatic species. The forestland contained within these two areas is considered covered lands under the FPHCP (FPHCP, Section 1-5, Lands covered by the plan, 2004).

Within the area described above, the action area includes the fish-bearing and non-fish-bearing streams and rivers, all stream- and river-associated wetlands, and a limited extent of nearshore marine habitat. More detail regarding the extent of stream mileage is provided below, in the description of the Environmental baseline.

The action area is used by each of the salmonid ESUs and other aquatic species listed in Table 1, above. The life histories expressed by each of these ESUs or species will be described in the Status of the ESUs and Environmental Baseline sections of this Opinion, below.

2.0 ENDANGERED SPECIES ACT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with U.S. Fish and Wildlife Service and NOAA's National Marine Fisheries Service (NMFS), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their critical habitats. Section 7(b)(4) requires the provision of an incidental take statement specifying the impact of any incidental taking and specifying reasonable and prudent measures to minimize such impacts.

2.1 Biological Opinion

This Opinion presents NMFS' review of the status of each Evolutionarily Significant Unit (ESU)[1] considered in this consultation and critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects. NMFS analyzes those combined factors to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected ESUs, or is likely to destroy or adversely modify critical habitat (50 CFR 402.14(g)).

The critical habitat analysis determines whether the proposed action will destroy or adversely modify designated or proposed critical habitat for ESA-listed species by examining any change in the conservation value of the essential features of that critical habitat. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

If the action under consultation is likely to jeopardize an ESU, or destroy or adversely modify critical habitat, NMFS must identify any reasonable and prudent alternatives for the action that avoid jeopardy or destruction or adverse modification of critical habitat and meet other regulatory requirements (50 CFR 402.02).

2.1.1 Status of the Species

This section defines range-wide biological requirements of each species, and reviews the status of the species relative to those requirements. This Opinion uses the terminology "evolutionarily significant units" (ESUs) to discuss species of Pacific salmonids and "Distinct Population Segments" (DPSs) to discuss species of steelhead. An ESU of Pacific salmon (Waples 1991) and a DPS of steelhead (January 5, 2006, 71 FR 834)) are considered to be "species" (the latter is defined in Section 3 of the ESA). This represents a change from previous status reviews for *O.*

[1] 'ESU' means an anadromous salmon or steelhead population that is either listed or being considered for listing under the ESA, is substantially isolated reproductively from conspecific populations, and represents an important component of the evolutionary legacy of the species (Waples 1991). An ESU may include portions or combinations of populations more commonly defined as stocks within or across regions.

mykiss, where species were described using the ESU terminology. Because of that change in terminology, this Opinion refers to steelhead DPSs throughout the assessment, even when citing previous status reviews that used the ESU terminology.

The present risk faced by each ESU and DPS informs NMFS' determination of whether additional risk will "appreciably reduce" the likelihood that an ESU will survive and recover in the wild. The greater the present risk, the more likely that any additional risk resulting from the proposed action's effects on the population size, productivity (growth rate), distribution, or genetic diversity of the ESU will be an appreciable reduction (see McElhany et al., 2000).

The biological requirements of salmon and steelhead considered in this consultation vary depending on the life history stage present and the natural range of variation present within that system (Groot and Margolis 1991, NRC 1996, Spence et al., 1996). Generally, during spawning migrations, adult salmon require clean water with cool temperatures and access to thermal refugia, dissolved oxygen near 100 percent saturation, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Anadromous fish select spawning areas based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling. Embryo survival and fry emergence depend on substrate conditions (e.g., gravel size, porosity, permeability, and oxygen concentrations), substrate stability during high flows, and, for most species, water temperatures of 13 degrees Celsius or less. Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting. Migration of juveniles to rearing areas, whether the ocean, lakes, or other stream reaches, requires unobstructed access to these habitats. Physical, chemical, and thermal conditions may all impede migrations of adult or juvenile fish.

NMFS reviews the range-wide status of the species affected by the proposed action using criteria that describe a "Viable Salmonid Population" (VSP) (McElhany et al., 2000). Attributes associated with a VSP include the abundance, productivity, spatial structure, and genetic diversity to enhance its capacity to adapt to various environmental conditions and allow it to become self-sustaining in the natural environment. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle, characteristics that are influenced in turn by habitat and other environmental conditions.

To be considered viable, with a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over the long term, an ESU should have the following characteristics. It should contain multiple populations so that a single catastrophic event is less likely to cause the ESU to become extinct, and so that the ESU may function as a "metapopulation" as necessary to sustain population-level extinction and recolonization processes. Multiple populations within an ESU also increase the likelihood that a diversity of phenotypic and genotypic characteristics will be maintained, thus allowing natural evolutionary processes to operate and increase the ESUs long-term viability. Some of the ESU's populations should be relatively large and productive to further reduce the risk of extinction in response to a single catastrophic event that affects all populations. If an ESU consists of only one population, that population must be as large and productive ("resilient") as possible. Some populations in each ESU should be geographically widespread to reduce the risk that spatially-correlated environmental catastrophes will drive the ESU to extinction. Other populations in the same ESU should be geographically close to each other to increase connectivity between existing populations and encourage metapopulation function. Populations with diverse life-histories and phenotypes should be maintained in each ESU to further reduce the risk of correlated environmental catastrophes or changes in environmental conditions that occur too rapidly for an evolutionary response, and to maintain genetic diversity that allows natural evolutionary processes to operate within an ESU. Finally, evaluations of ESU status should take into account uncertainty about ESU-level processes. Our understanding of ESU-level spatial and temporal processes is limited such that the historical number and distribution of populations serve as a useful goal in maintaining viability of ESUs that likely were historically self-sustaining.

2.1.1.1 Listed Salmonids

2.1.1.1.1 Snake River Sockeye. The Snake River sockeye ESU includes populations of anadromous sockeye salmon from the Snake River Basin, Idaho (extant populations occur only in the Stanley Basin) (November 20, 1991, 56 FR 58619), residual sockeye salmon in Redfish Lake, Idaho, as well as one captive propagation hatchery program. Artificially propagated sockeye salmon from the Redfish Lake Captive Propagation program are considered part of this ESU. NMFS determined that this artificially propagated stock is no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a).

Subsequent to the 1991 listing determination for the Snake River sockeye ESU, a “residual” form of Snake River sockeye (hereafter "residuals") was identified. The residuals often occur together with anadromous sockeye salmon and exhibit similar behavior in the timing and location of spawning. Residuals are thought to be the progeny of anadromous sockeye salmon, but are generally nonanadromous. In 1993 NMFS determined that the residual population of Snake River sockeye that exists in Redfish Lake is substantially reproductively isolated from kokanee (i.e., nonanadromous populations of *O. nerka* that become resident in lake environments over long periods of time), represents an important component in the evolutionary legacy of the biological species, and thus merits inclusion in the Snake River sockeye ESU.

The residual form of Redfish Lake sockeye is represented by a few hundred fish. Snake River sockeye historically were distributed in four lakes within the Stanley Basin, but the only remaining population resides in Redfish Lake. Only 16 naturally produced adults have returned to Redfish Lake since the Snake River sockeye ESU was listed as an endangered species in 1991. All 16 fish were taken into the Redfish Lake Captive Propagation Program, which was initiated as an emergency measure in 1991. The return of over 250 adults in 2000 was encouraging; however, subsequent returns from the captive program in 2001 and 2002 have been fewer than 30 fish.

The BRT found extremely high risks for each of the four VSP categories. Informed by this assessment, the BRT unanimously concluded that the Snake River sockeye ESU is "in danger of extinction"(Good et al., 2005).

There is a single artificial propagation program producing Snake River sockeye that was originally founded by collecting the entire anadromous adult return of 16 fish between 1990 and 1997, the collection of a small number of residual sockeye salmon, and the collection of a few hundred smolts migrating from Redfish Lake. These fish were put into a Captive Broodstock program as an emergency measure to prevent extinction of this ESU. Since 1997, nearly 400 hatchery-origin anadromous sockeye adults have returned to the Stanley Basin from juveniles released by the program. Redfish Lake sockeye salmon have also been reintroduced into Alturas and Pettit Lakes using progeny from the captive broodstock program. The captive broodstock program presently consists of several hundred fish of different year classes maintained at facilities in Eagle (Idaho) and Manchester (Washington).

NMFS assessment of the effects of artificial propagation on ESU extinction risk concluded that the Redfish Lake Captive Broodstock Program does not substantially reduce the extinction risk of the ESU in-total (NMFS, 2004d). The Artificial Propagation Evaluation Workshop noted that the Captive Broodstock Program has prevented likely extinction of the ESU. This program has increased the total number of anadromous adults, attempted to increase the number of lakes in which sockeye salmon are present in the upper Salmon River (Stanley Basin), and preserved what genetic diversity remains in the ESU. Although the program has increased the number of anadromous adults in some years, it has yet to produce consistent returns. The majority of the ESU now resides in the captive program composed of only a few hundred fish. The long-term effects of captive rearing are unknown. The consideration of artificial propagation does not substantially mitigate the BRT's assessment of extreme risks to ESU abundance, productivity, spatial structure, and diversity. Informed by the BRT's findings (NMFS, 2003) and our assessment of the effects of artificial propagation on the viability of the ESU, the Artificial Propagation Evaluation Workshop concluded that the Snake River sockeye ESU in-total is "in danger of extinction" (NMFS, 2004d).

2.1.1.1.2 Ozette Lake Sockeye. The Ozette Lake sockeye ESU includes all naturally spawned populations of sockeye salmon in Ozette Lake and streams and tributaries flowing into Ozette Lake, Washington (March 25, 1999, 64 FR 14528). Two artificial propagation programs are considered to be part of this ESU: the Umbrella Creek and Big River sockeye hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a). Siltation and alterations in the lake level regime have resulted in the loss of numerous beach spawning sites. The BRT expressed concern that the reduction in the number of spawning aggregations poses risks for ESU spatial structure and diversity. Primary sources of threats to VSP parameters include: loss of adequate quality and quantity of spawning and rearing habitat, predation and disruption of natural predator-prey relationships, introduction of nonnative fish and plant species, past overexploitation, poor ocean conditions, and interactions among those factors (NMFS 2005b). There has been no directed harvest on Lake Ozette sockeye salmon since 1982, and commercial fisheries stopped in 1974

(Gustafson et al., 1997, Makah Fisheries Management 2000).

The Puget Sound TRT considers the Lake Ozette sockeye salmon ESU to be composed of one historical population, with substantial substructuring of individuals into multiple spawning aggregations. The primary existing spawning aggregations occur in two beach locations—Allen's and Olsen's beaches, and in two tributaries, Umbrella Creek and Big River (both tributary-spawning groups were initiated through a hatchery introduction program). Recently, mature adults have been located at other beach locations within the lake (e.g., Umbrella Beach, Ericson's Bay, Baby Island, and Boot Bay), but whether spawning occurred in those locations is not known (Makah Fisheries Management 2000). Similarly, occasional spawners are found sporadically in other tributaries to the lake, but not in as high numbers or as consistently as in Umbrella Creek. The Umbrella Creek spawning aggregation was started through collections of lake-spawning adults as initial broodstock, and in recent years all broodstock has been collected from returning adults to Umbrella Creek (Makah Fisheries Management 2000). The extent to which sockeye spawned historically in tributaries to the lake is controversial (Gustafson et al., 1997), but it is clear that multiple beach-spawning aggregations of sockeye occurred historically, and that genetically distinct kokanee currently spawn in large numbers in all surveyed lake tributaries (except Umbrella Creek and Big River). The two remaining beach-spawning aggregations are probably fewer than the number of aggregations that occurred historically, but there is insufficient evidence to determine how many subpopulations occurred in the ESU historically.

Much of the existing spawning in recent years occurs in the spawning aggregation created via fry releases into Umbrella Creek. The status of the historically well-documented spawning aggregations at Allen's and Olsen's beaches is not well understood because of the difficulties in observing spawners and sampling carcasses in the tannin-rich lake. Although the program has a beneficial effect on ESU abundance and spatial structure, it has neutral or uncertain effects on ESU productivity and diversity (NMFS 2005a).

The 5-year average (geometric mean) estimated abundance of Ozette Lake sockeye salmon ESU for the period 1994–1998 was 580, slightly below the average of 700 (for the years 1992–1996) reported by Gustafson et al. (1997). This decrease is largely because the earlier average included two dominant brood-cycle years, although the recent average includes only one. The 1998 count of 984 was substantially higher than the count of 498 that was observed four years (one generation) earlier. This count may result primarily from a change in counting methods; a video camera was installed in 1998, and the operation period of the weir was expanded (7 May–14 August), resulting in a more complete count of all fish passing the weir. It is likely that counts for previous years underestimated total spawner abundance, but the magnitude of this bias is unknown. Analyses of trends using data through 1998 indicate that the short-term (10-year) trend improved from a decline of 9.9 percent per year in Gustafson et al. (1997) to a relatively low, 2 percent, annual increase. How much this increase was influenced by the change in counting methods in 1998 is not known. The long-term trend remained slightly downward (–2 percent).

2.1.1.1.3 Upper Willamette River Chinook. The Upper Willamette River Chinook ESU includes all naturally spawned populations of spring-run Chinook salmon in the Clackamas River and in the Willamette River, and its tributaries, above Willamette Falls, Oregon (March 24, 1999, 64 FR 14208). Seven artificial propagation programs are considered to be part of the ESU: the McKenzie River Hatchery (Oregon Department of Fish and Wildlife (ODFW) stock # 24), Marion Forks/North Fork Santiam River (ODFW stock # 21), South Santiam Hatchery (ODFW stock # 23) in the South Fork Santiam River, South Santiam Hatchery (ODFW stock # 23) in the Calapooia River, South Santiam Hatchery (ODFW stock # 23) in the Mollala River, Willamette Hatchery (ODFW stock # 22), and Clackamas hatchery (ODFW stock # 19) spring-run Chinook hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS 2005a).

There are no direct estimates of natural-origin spawner abundance for the Upper Willamette River Chinook ESU. The abundance of adult spring Chinook salmon (hatchery and natural fish) passing Willamette Falls has remained relatively steady over the past 50 years (ranging from approximately 20,000 to 70,000 fish), but is only a fraction of peak abundance levels observed in the 1920s (approximately 300,000 adults). Interpretation of abundance levels is confounded by a high but uncertain fraction of hatchery produced fish. The McKenzie River population has shown substantial increases in total abundance (hatchery origin and natural origin fish) in the last two years, while trends in other natural populations in the ESU are generally mixed. With the relatively large incidence of naturally spawning hatchery fish in the ESU, it is difficult to determine trends in productivity for natural-origin fish. The BRT estimated that despite improving trends in total productivity (including hatchery origin and natural origin fish) since 1995, productivity would be below replacement in the absence of artificial propagation. The BRT was particularly concerned that approximately 30 to 40 percent of total historical habitat is now inaccessible behind dams. These inaccessible areas, however, represent a majority of the historical spawning habitat. The restriction of natural production to just a few areas increases the ESU's vulnerability to environmental variability and catastrophic events. Losses of local adaptation and genetic diversity through the mixing of hatchery stocks within the ESU, and the introgression of out-of-ESU hatchery fall-run Chinook, have represented threats to ESU diversity. However, the BRT was encouraged by the recent cessation of releases of the fall-run hatchery fish, as well as by improved marking rates of hatchery fish to assist in monitoring and in the management of a marked-fish selective fishery (Good et al., 2005).

The BRT found moderately high risks for all VSP categories. Informed by this risk assessment, the strong majority opinion of the BRT was that the naturally spawned component of the Upper Willamette River Chinook ESU is "likely to become endangered within the foreseeable future." The minority opinion was that this ESU is "in danger of extinction." Seven artificial propagation programs in the Willamette River produce fish that are considered to be part of the Upper Willamette River Chinook ESU. All of these programs are funded to mitigate for lost or degraded habitat and produce fish for harvest purposes.

NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS, 2004d). An increasing proportion of hatchery-origin returns has contributed to increases in total ESU abundance. However, it is unclear whether these returning hatchery and natural fish actually survive overwintering to spawn. Estimates of pre-spawning mortality indicate that a high proportion (greater than 70 percent) of spring Chinook die before spawning in most ESU populations. In recent years, hatchery fish have been used to reintroduce spring Chinook back into historical habitats above impassible dams (e.g., in the South Santiam, North Santiam, and McKenzie Rivers), slightly decreasing risks to ESU spatial structure. Hatchery fish within the ESU exhibit differing life-history characteristics from natural ESU fish. High proportions of hatchery-origin natural spawners in remaining natural production areas (i.e., in the Clackamas and McKenzie Rivers) may thereby have negative impacts on within and among population genetic and life-history diversity. Collectively, artificial propagation programs in the ESU have a slight beneficial effect on ESU abundance and spatial structure, but neutral or uncertain effects on ESU productivity and diversity. Informed by the BRT's findings (NMFS 2003) and our assessment of the effects of artificial propagation programs on the viability of the ESU the Artificial Propagation Evaluation Workshop concluded that the Upper Willamette River Chinook ESU in-total is "likely to become endangered in the foreseeable future" (NMFS, 2004d).

2.1.1.1.4 Lower Columbia River Chinook. The Lower Columbia River Chinook ESU includes all naturally spawned populations of Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River (March 24, 1999, 64 FR 14208). Seventeen artificial propagation programs are considered to be part of the ESU: the Sea Resources Tule Chinook Program, Big Creek Tule Chinook Program, Astoria High School (STEP) Tule Chinook Program, Warrenton High School (STEP) Tule Chinook Program, Elochoman River Tule Chinook Program, Cowlitz Tule Chinook Program, North Fork Toutle Tule Chinook Program, Kalama Tule Chinook Program, Washougal River Tule Chinook Program, Spring Creek NFH Tule Chinook Program, Cowlitz spring Chinook Program in the Upper Cowlitz River and the Cispus River, Friends of the Cowlitz spring Chinook Program, Kalama River spring Chinook Program, Lewis River spring Chinook Program, Fish First spring Chinook Program, and the Sandy River Hatchery (ODFW stock #11) Chinook hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a).

Many populations within the Lower Columbia River Chinook ESU have exhibited pronounced increases in abundance and productivity in recent years, possibly due to improved ocean conditions. Abundance estimates of naturally spawned populations in this ESU, however, are uncertain due to a high (approximately 70 percent) fraction of naturally spawning hatchery fish and a low marking rate (only 1 to 2 percent) of hatchery produced fish. Abundance estimates of naturally produced spring Chinook have improved since 2001 due to the marking of all hatchery spring Chinook releases, allowing for the enumeration of hatchery spring Chinook at weirs, traps and on spawning grounds. Despite recent improvements, long-term trends in productivity are below replacement for the majority of populations in the ESU. It is estimated that eight to 10 of approximately 31 historical populations in the ESU have been extirpated or nearly extirpated. Although approximately 35 percent of historical habitat has been lost in this ESU due to the construction of dams and other impassable barriers, this ESU exhibits a broad spatial distribution in a variety of watersheds and habitat types. Natural production currently occurs in approximately 20 populations, although only one population has a mean spawner abundance exceeding 1,000 fish. The BRT expressed concern that the spring-run populations comprise most of the extirpated populations. The disproportionate loss of the spring-run life history represents a risk for ESU diversity. Additionally, of the four hatchery spring-run Chinook populations considered to be part of this ESU, two are propagated in rivers that are within the historical geographic range of the ESU but that likely did not support spring-run populations. High hatchery production in the Lower Columbia River poses genetic and ecological risks to the natural populations in the ESU, and complicates assessments of their performance. The BRT also expressed concern over the introgression of out-of-ESU hatchery stocks.

The BRT found moderately high risks for all VSP categories (Good et al., 2005). Informed by this risk assessment, the majority opinion of the BRT was that the naturally spawned component of the Lower Columbia River Chinook ESU is "likely to become endangered within the foreseeable future," with the minority being split between "in danger of extinction" and "not in danger of extinction or likely to become endangered within the foreseeable future."

There are 17 artificial propagation programs are designed to produce fish for harvest, with three of these programs also being implemented to augment the naturally spawning populations in the basins where the fish are released. These three programs integrate naturally produced spring Chinook salmon into the broodstock in an attempt to minimize the genetic effects of returning hatchery adults that spawn naturally.

NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS, 2004d). Hatchery programs have increased total returns and numbers of fish spawning naturally, thus reducing risks to ESU abundance. Although these hatchery programs have been successful at producing substantial numbers of fish, their effect on the productivity of the ESU in-total is uncertain. Additionally, the high level of hatchery production in this ESU poses potential genetic and ecological risks to the ESU, and confounds the monitoring and evaluation of abundance trends and productivity. The Cowlitz River spring Chinook salmon program produces parr for release into the upper Cowlitz River Basin in an attempt to re-establish a naturally spawning population above Cowlitz Falls Dam. Such reintroduction efforts increase the ESU's spatial distribution into historical habitats, and slightly reduce risks to ESU spatial structure. The few programs that regularly integrate natural fish into the broodstock may help preserve genetic diversity within the ESU. However, the majority of hatchery programs in the ESU have not converted to the regular incorporation of natural broodstock, thus limiting this risk reducing feature at the ESU scale. Past and ongoing transfers of broodstock among hatchery programs in different basins represent a risk to within and among population diversity. Collectively, artificial propagation programs in the ESU provide slight benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity. Informed by the BRT's findings (NMFS 2003) and our assessment of the effects of artificial propagation programs on the viability of the ESU, the Artificial Propagation Evaluation Workshop concluded that the Lower Columbia River Chinook ESU in-total is "likely to become endangered in the foreseeable future" (NMFS, 2004d).

2.1.1.1.5 Upper Columbia River Spring-run Chinook. The Upper Columbia River spring-run Chinook ESU includes all naturally spawned populations of Chinook salmon in all river reaches accessible to Chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River (March 24, 1999, 64 FR 14208). Six artificial propagation programs are considered to be part of the ESU: the Twisp River, Chewuch River, Methow Composite, Winthrop NFH, Chiwawa River, and White River spring-run Chinook hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a).

All populations in the Upper Columbia River spring-run Chinook ESU exhibited pronounced increases in abundance in 2001. These increases are particularly encouraging following the last decade of steep declines to record, critically low escapements. Despite strong returns in 2001, both recent five year and long term productivity trends remain below replacement. The five hatchery spring-run Chinook populations considered to be part of this ESU are programs aimed at supplementing natural production areas. These programs have contributed substantially to the abundance of fish spawning naturally in recent years. However, little information is available to assess the impact of these high levels of supplementation on the long-term productivity of natural populations. Spatial structure in this ESU was of little concern as there is passage and connectivity among almost all ESU populations, although it is estimated that approximately 58 percent of historical habitat has been lost. During years of critically low escapement (1996 and 1998) extreme management measures were taken in one of the three major spring Chinook producing basins by collecting all returning adults into hatchery supplementation programs. Such actions reflect the ongoing vulnerability of certain segments of this ESU. The BRT expressed concern that these actions, while appropriately guarding against the catastrophic loss of populations, may have compromised ESU population structure and diversity.

The BRT's assessment of risk for the four VSP categories reflects strong concerns regarding abundance and productivity, and comparatively less concern for ESU spatial structure and diversity. The BRT's assessment of overall extinction risk faced by the naturally spawned component of the Upper Columbia River spring-run Chinook ESU was divided between "in danger of extinction" and "likely to become endangered within the foreseeable future," with a slight majority opinion that the ESU is "in danger of extinction" (Good et al., 2005).

Six artificial propagation programs in the Upper Columbia River Basin produce spring-run Chinook in the Methow and Wenatchee Rivers that are considered to be part of the Upper Columbia River spring-run Chinook ESU. The Entiat NFH operating in the Entiat River is not included in the ESU, and is intended to remain isolated from the local natural population. The within ESU hatchery programs are conservation programs intended to contribute to the recovery of the ESU by increasing the abundance and spatial distribution of naturally spawned fish, while maintaining the genetic integrity of populations within the ESU. Three of the conservation programs incorporate local natural broodstock to minimize adverse genetic effects, and follow broodstock protocols guarding against the overcollection of the natural run. The remaining within-ESU hatchery programs are captive broodstock programs. These programs also adhere to strict protocols for the collection, rearing, maintenance, and mating of the captive brood populations. All of the six artificial propagation programs considered to be part of the ESU include extensive monitoring and evaluation efforts to continually evaluate the extent and implications of any genetic and behavioral differences that might emerge between the hatchery and natural stocks.

Genetic evidence suggests that the within-ESU programs remain closely related to the naturally spawned populations and maintain local genetic distinctiveness of populations within the ESU. The captive broodstock programs may exhibit lower fecundity and younger average age-at-maturity compared to the natural populations from which they were derived. However, the extensive monitoring and evaluation efforts employed afford the adaptive management of any unintended adverse effects. Habitat Conservation Plans (HCPs) with the Chelan and Douglas Public Utility Districts and binding mitigation agreements ensure that these programs will have secure funding and will continue into the future. These hatchery programs have undergone ESA section 7 consultation to ensure that they do not jeopardize the continued existence of the ESU, and they have received ESA section 10 permits for production through 2007. Annual reports and other specific information reporting requirements ensure that the terms and conditions as specified by NMFS are followed. These programs, through adherence to best professional practices, have not experienced disease outbreaks or other catastrophic losses.

NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS, 2004d). Overall, the hatchery programs in the ESU have increased the total abundance of fish considered to be part of the ESU. Specifically, the two hatchery programs in the Wenatchee Basin have contributed to reducing abundance risk. However, it is uncertain whether the four programs in the Methow Basin have provided a net benefit to abundance. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. The overall impact of the hatchery programs on ESU spatial structure is neutral. The Wenatchee Basin programs are managed to promote appropriate spatial structure, and they likely reduce spatial structure risk in that basin. The Methow Basin hatchery programs, however, concentrate spawners near the hatchery facilities, altering population spatial structure and increasing vulnerability to catastrophic events. Overall, within-ESU hatchery programs do not moderate risks to ESU diversity. The Wenatchee Basin programs do help preserve population diversity though the incorporation of natural-origin fish into broodstock. The Methow Basin programs, however, incorporate few natural fish with hatchery-origin fish predominating on the spawning grounds. Additionally, the presence of out-of-ESU Carson stock Chinook in the Methow Basin remains a concern, although the stock is in the process of being terminated. The out-of-ESU Entiat hatchery program is a source of significant concern to the ESU. The Entiat stock may have introgressed significantly with or replaced the native population. Although the artificial propagation programs in the ESU have a slight beneficial effect on ESU abundance, they do not mitigate other key risk factors identified by the BRT. Informed by the BRT's findings (NMFS, 2003) and our assessment of the effects of artificial propagation programs on the viability of the ESU, the Artificial Propagation Evaluation Workshop concluded that the Upper Columbia River spring-run Chinook ESU in-total is "in danger of extinction" (NMFS, 2004d).

2.1.1.1.6 Puget Sound Chinook. The Puget Sound Chinook ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington (March 24, 1999, 64 FR 14208). The Puget Sound Chinook salmon ESU is composed of 31 historically quasi-independent populations, 22 of which are believed to be extant currently (Puget Sound TRT 2001, 2002). The populations presumed to be extinct are mostly early returning fish; most of these are in mid- to southern Puget Sound or Hood Canal and the Strait of Juan de Fuca. The ESU populations with the greatest estimated fractions of hatchery fish tend to be in mid- to southern Puget Sound, Hood Canal, and the Strait of Juan de Fuca.

Habitat was identified as throughout the Puget Sound Chinook ESU has been blocked or degraded (NMFS and USFWS 2005). In general, forest practices impacted upper tributaries, and agriculture or urbanization impacted lower tributaries and mainstem rivers. The WDF et al. (1993) cited diking for flood control, draining and filling of freshwater and estuarine wetlands, and sedimentation due to forest practices and urban development as problems throughout the ESU. Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in several basins. Bishop and Morgan (1996) identified a variety of critical habitat issues for streams in the range of this ESU, including changes in flow regime (all basins), sedimentation (all basins), high temperatures (Dungeness, Elwha, Green/Duwamish, Skagit, Snohomish, and Stillaguamish rivers), streambed instability (most basins), estuarine loss (most basins), loss of large woody debris (Elwha, Snohomish, and White rivers), loss of pool habitat (Nooksack, Snohomish, and Stillaguamish rivers), and blockage or passage problems associated with dams or other structures (Cedar, Elwha, Green/Duwamish, Snohomish, and White rivers).

Twenty-six artificial propagation programs are considered to be part of the ESU. Eight of the programs are directed at conservation, and are specifically implemented to preserve and increase the abundance of native populations in their natal watersheds where habitat needed to sustain the populations naturally at viable levels has been lost or degraded. Each of these conservation hatchery programs includes research, monitoring, and evaluation activities designed to determine success in recovering the propagated populations to viable levels, and to determine the demographic, ecological, and genetic effects of each program on target and non-target salmonid populations. The remaining programs considered to be part of the ESU are operated primarily for fisheries harvest augmentation purposes (some of which also function as research programs) using transplanted within-ESU-origin Chinook salmon as broodstock. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a).

Assessing extinction risk for the Puget Sound Chinook ESU is complicated by high levels of hatchery production and a limited availability of information on the fraction of natural spawners that are of hatchery-origin. Although populations in the ESU have not experienced the dramatic increases in abundance in the last 2 to 3 years that have been evident in many other ESUs, more populations have shown modest increases in escapement in recent years than have declined (13 populations versus nine). Most populations have a recent five-year mean abundance of fewer than 1,500 natural spawners, with the Upper Skagit population being a notable exception (the recent five-year mean abundance for the Upper Skagit population approaches 10,000 natural spawners). Currently observed abundances of natural spawners in the ESU are several orders of magnitude lower than estimated historical spawner capacity, and well below peak historical abundance (approximately 690,000 spawners in the early 1900s). Recent five-year and long-term productivity trends remain below replacement for the majority of the 22 extant populations of Puget Sound Chinook. The BRT was concerned that the concentration of the majority of natural production in just a few subbasins represents a significant risk. Natural production areas, due to their concentrated spatial distribution, are vulnerable to extirpation due to catastrophic events. The BRT was concerned by the disproportionate loss of early run populations and its impact on the diversity of the Puget Sound Chinook ESU. The Puget Sound Technical Recovery Team has identified 31 historical populations (Ruckelshaus et al., 2002), nine of which are believed to be extinct, most of which were "early run" or "spring" populations. Past hatchery practices that transplanted stocks among basins within the ESU and present programs using transplanted stocks that incorporate little local natural broodstock represent additional risk to ESU diversity. In particular, the BRT noted that the pervasive use of Green River stock, and stocks subsequently derived from the Green River stock, throughout the ESU may reduce the genetic diversity and fitness of naturally spawning populations.

The BRT found moderately high risks for all VSP categories. Informed by this risk assessment, the strong majority opinion of the BRT was that the naturally spawned component of the Puget Sound Chinook ESU is "likely to become endangered within the foreseeable future." The minority opinion was in the "not in danger of extinction or likely to become endangered within the foreseeable future" category (Good et al., 2005).

In terms of productivity, these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS, 2004d). However, long-term trends in abundance for naturally spawning populations of Chinook salmon in Puget Sound indicate that approximately half the populations are declining, and half are increasing in abundance over the length of available time series. The median over all populations of long-term trend in abundance is 1.0 (range 0.92–1.2), indicating that most populations are just replacing themselves. Over the long term, the most extreme declines in natural spawning abundance have occurred in the combined Dosewallips and Elwha populations. Those populations with the greatest long-term population growth rates are the North Fork Nooksack and White rivers. All populations reported above are likely to have a moderate to high fraction of naturally spawning hatchery fish, so it is not possible to say what the trends in naturally spawning, natural-origin Chinook salmon might be in those populations. White River spring Chinook (among others) were the subject of discussions with the Tribes during consultation because their life history is adapted to glacial runoff patterns. This life history distinguishes the White River spring Chinook from most of the other Puget Sound Chinook populations increasing their importance to recovery of Puget Sound Chinook for their contribution to life history diversity within the ESU.

Fewer populations exhibit declining trends in abundance over the short term than over the long term—4 of 22 populations in the ESU declined from 1990 to 2002 (median = 1.06, range = 0.96–1.4) (Good et al., 2005). In contrast, estimates of short-term population growth rates suggest a very different picture when the reproductive success of hatchery fish is assumed to be 1.

The populations with the most positive short-term trends and population growth rates are the combined Dosewallips and White river populations. Both of these populations are thought to have a moderate fraction of naturally spawning hatchery fish, but because such estimates are not available, estimating the trends in natural-origin spawners is not possible (Good et al., 2005). The most extreme short-term declines in natural spawner abundance have occurred in the upper Sauk, Cedar, Puyallup, and Elwha populations. Of these populations, only the upper Sauk is likely to have a low fraction of hatchery fish in escapements (Good et al., 2005). When change in abundance is calculated assuming the reproductive success of hatchery fish is equivalent to that of natural-origin fish, the biggest estimated short-term population declines are in the Green, Skykomish, North Fork Stillaguamish, and North Fork Nooksack populations (Good et al., 2005).

2.1.1.1.7 Snake River Fall-run Chinook. The Snake River fall-run Chinook ESU includes all naturally spawned populations of fall-run Chinook salmon in the mainstem Snake River below Hells Canyon Dam, and in the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River subbasins (April 22, 1992, 57 FR 14653; June 3, 1992, 57 FR 23458). Four artificial propagation programs are considered to be part of the ESU: the Lyons Ferry Hatchery, Fall Chinook Acclimation Ponds Program, Nez Perce Tribal Hatchery, and Oxbow Hatchery fall-run Chinook hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a).

The abundance of natural-origin spawners in the Snake River fall-run Chinook ESU for 2001 (2,652 adults) was in excess of 1,000 fish for the first time since counts began at the Lower Granite Dam in 1975. The recent five-year mean abundance of 871 naturally produced spawners, however, generated concern that despite recent improvements, the abundance level is very low for an entire ESU. With the exception of the marked increase in 2001, the ESU has fluctuated between approximately 500 to 1,000 natural spawners since 1975, suggesting a higher degree of stability in growth rate at low population levels than is seen in other salmonid populations. Increasing returns reflect improved ocean conditions, improved management of the mainstem hydrosystem flow regime, decreased harvest, and an increasing contribution from the Lyons Ferry Hatchery supplementation program. However, due to the large fraction of naturally spawning hatchery fish, it is difficult to assess the productivity of the natural population. Depending upon the assumption made regarding the reproductive contribution of hatchery fish, long-term and short-term trends in productivity are at or above replacement.

It is estimated that approximately 80 percent of historical spawning habitat was lost (including the most productive areas) with the construction of a series of Snake River mainstem dams. The loss of spawning habitats and the restriction of the ESU to a single extant naturally spawning population increase the ESU's vulnerability to environmental variability and catastrophic events. The diversity associated with populations that once resided above the Snake River dams has been lost, and the impact of straying out-of-ESU fish has the potential to further compromise ESU diversity. Recent improvements in the marking of out-of-ESU hatchery fish and their removal at Lower Granite Dam have reduced the impact of these strays. However, introgression below Lower Granite Dam remains a concern. The BRT voiced concern that the practice of collecting fish below Lower Granite Dam for broodstock incorporates non-ESU strays into the Lyons Ferry Hatchery program, and poses additional risks to ESU diversity. Straying of out-of-ESU hatchery fall Chinook salmon from outside the Snake River Basin was identified as a major risk factor in the late 1980s to mid 1990s. Out-of-ESU hatchery strays have been much reduced due to the removal of hatchery strays at downstream dams, and a reduction in the number of fish released into the Umatilla River (where the majority of out-of-ESU strays originated).

The BRT found moderately high risk for all VSP categories. Informed by this risk assessment, the majority opinion of the BRT was that the naturally spawned component of the Snake River fall-run Chinook ESU is "likely to become endangered within the foreseeable future." The minority opinion assessed ESU extinction risk as "in danger of extinction," although a slight minority fell in the "not in danger of extinction or likely to become endangered within the foreseeable future" category (Good et al., 2005).

The four artificial propagation programs producing Snake River fall Chinook salmon in the Snake River basin are based on the Lyons Ferry Hatchery stock and considered to be part of the Snake River fall-run Chinook ESU. When naturally spawning fall Chinook declined to fewer than 100 fish in 1991, most of the genetic legacy of this ESU was preserved in the Lyons Ferry Hatchery broodstock (NMFS 1991). These four hatchery programs are managed to enhance listed Snake River fall Chinook salmon and presently include the Lyons Ferry Hatchery, Fall Chinook Acclimation Ponds Program, Nez Perce Tribal Hatchery, and Oxbow Hatchery (an Idaho Power Company mitigation hatchery). These existing programs release fish into the mainstem Snake River and Clearwater River which represent the majority of the remaining habitat available to this ESU.

NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS, 2004d). These hatchery programs have contributed to the recent substantial increases in total ESU abundance, including both natural-origin and hatchery-origin ESU components. Spawning escapement has increased to several thousand adults (from a few hundred in the early 1990s) due in large part to increased releases from these hatchery programs. These programs collectively have had a beneficial effect on ESU abundance in recent years. The

BRT noted, however, that the large but uncertain fraction of naturally spawning hatchery fish complicates assessments of ESU productivity. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. As ESU abundance has increased in recent years, ESU spatial distribution has increased. The Snake River fall-run Chinook hatchery programs contributed to this reduction in risk to ESU spatial distribution. The Lyons Ferry stock has preserved genetic diversity during critically low years of abundance. However, the ESU-wide use of a single hatchery broodstock may pose long-term genetic risks, and may limit adaptation to different habitat areas. Although the ESU presently consists of a single independent population, it was most likely composed of diverse production centers. Additionally, the broodstock collection practices employed pose risks to ESU spatial structure and diversity. Release strategies practiced by the ESU hatchery programs (e.g., extended captivity for about 15 percent of the fish before release) is in conflict with the Snake River fall-run Chinook life history, and may compromise ESU diversity. Collectively, artificial propagation programs in the ESU provide slight benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity. Informed by the BRT's findings (NMFS, 2003) and our assessment of the effects of artificial propagation programs on the viability of the ESU, the Artificial Propagation Evaluation Workshop concluded that the Snake River fall-run Chinook ESU in-total is "likely to become endangered in the foreseeable future" (NMFS, 2004d).

2.1.1.1.8 Snake River Spring/Summer Chinook. The Snake River spring/summer-run Chinook ESU includes all naturally spawned populations of spring/summer-run Chinook salmon in the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins (June 3, 1992, 57 FR 23458). Fifteen artificial propagation programs are considered to be part of the ESU: the Tucannon River conventional Hatchery, Tucannon River Captive Broodstock Program, Lostine River, Catherine Creek, Lookingglass Hatchery Reintroduction Program (Catherine Creek stock), Upper Grande Ronde, Imnaha River, Big Sheep Creek, McCall Hatchery, Johnson Creek Artificial Propagation Enhancement, Lemhi River Captive Rearing Experiment, Pahsimeroi Hatchery, East Fork Captive Rearing Experiment, West Fork Yankee Fork Captive Rearing Experiment, and the Sawtooth Hatchery spring/summer-run Chinook hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a).

The aggregate return (including hatchery and natural-origin fish) of Snake River spring/summer-run Chinook in 2001 exhibited a large increase over recent abundances. Many, but not all, of the 29 natural production areas within the ESU experienced large abundance increases in 2001 as well, with two populations nearing the abundance levels specified in NMFS' 1995 Proposed Snake River Recovery Plan (NMFS, 1995). However, approximately 79 percent of the 2001 return of spring-run Chinook, was of hatchery origin. Short-term productivity trends were at or above replacement for the majority of natural production areas in the ESU, although long-term productivity trends remain below replacement for all natural production areas, reflecting the severe declines since the 1960s. Although the number of spawning aggregations lost in this ESU due to the establishment of the Snake River mainstem dams is unknown, this ESU has a wide spatial distribution in a variety of locations and habitat types. The BRT considered it a positive sign that the out-of-ESU Rapid River broodstock has been phased out of the Grande Ronde system. There is no evidence of wide-scale straying by hatchery stocks, thereby alleviating diversity concerns somewhat. Nonetheless, the high level of hatchery production in this ESU complicates the assessments of trends in natural abundance and productivity.

The BRT found moderately high risk for the abundance and productivity VSP criteria, and comparatively lower risk for spatial structure and diversity. Informed by this risk assessment, the majority opinion of the BRT was that the naturally spawned component of the Snake River spring/summer-run Chinook ESU is "likely to become endangered within the foreseeable future." The minority opinion assessed ESU extinction risk as "in danger of extinction," although a slight minority concluded that the ESU is in the "not in danger of extinction or likely to become endangered within the foreseeable future" category.

A portion of the 15 artificial propagation programs are managed to enhance listed natural populations, including the use of captive broodstock hatcheries in the upper Salmon River, Lemhi River, East Fork Salmon River, and Yankee Fork populations. These enhancement programs all use broodstocks founded from the local native populations. Currently, the use of non-ESU broodstock sources is restricted to Little Salmon/Rapid River (lower Salmon River tributary), mainstem Snake River at Hells Canyon, and the Clearwater River.

NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS, 2004d). Overall, these hatchery programs have contributed to the increases in total ESU abundance and in the number of natural spawners observed in recent years. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. Some reintroduction and outplanting of hatchery fish above barriers and into vacant habitat has occurred, providing a slight benefit to ESU spatial structure. All hatchery stocks within the ESU are derived from local natural populations and employ management practices designed to preserve genetic diversity. The Grande Ronde Captive Broodstock programs likely have prevented the extirpation of the local natural populations. Additionally, hatchery releases are managed to maintain wild fish reserves in the ESU in an effort to preserve natural local adaptation and genetic variability. Collectively, artificial propagation programs in the ESU provide benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity. Informed by the BRT's findings (NMFS 2003) and our assessment of the effects of artificial propagation programs on the viability of the ESU, the Artificial Propagation Evaluation Workshop concluded that the Snake River spring/summer-run Chinook ESU in-total is "likely to become endangered in the foreseeable future" (NMFS, 2004d).

2.1.1.1.8 Lower Columbia River Coho. The Lower Columbia River coho ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, and includes the Willamette River to Willamette Falls, Oregon. Twenty-five artificial propagation programs are considered to be part of the ESU: the Grays River, Sea Resources Hatchery, Peterson Coho Project, Big Creek Hatchery, Astoria High School (STEP) Coho Program, Warrenton High School (STEP) Coho Program, Elochoman Type-S Coho Program, Elochoman

Type-N Coho Program, Cathlamet High School FFA Type-N Coho Program, Cowlitz Type-N Coho Program in the Upper and Lower Cowlitz Rivers, Cowlitz Game and Anglers Coho Program, Friends of the Cowlitz Coho Program, North Fork Toutle River Hatchery, Kalama River Type-N Coho Program, Kalama River Type-S Coho Program, Lewis River Type-N Coho Program, Lewis River Type-S Coho Program, Fish First Wild Coho Program, Fish First Type-N Coho Program, Syverson Project Type-N Coho Program, Washougal River Type-N Coho Program, Eagle Creek NFH, Sandy Hatchery, and the Bonneville/Cascade/Oxbow complex coho hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a).

There are only two extant populations in the Lower Columbia River coho ESU with appreciable natural production (the Clackamas and Sandy River populations), from an estimated 23 historical populations in the ESU. Although adult returns in 2000 and 2001 for the Clackamas and Sandy River populations exhibited moderate increases, the recent five-year mean of natural-origin spawners for both populations represents less than 1,500 adults. The Sandy River population has exhibited recruitment failure in five of the last 10 years, and has exhibited a poor response to reductions in harvest. During the 1980s and 1990s natural spawners were not observed in the lower tributaries in the ESU. Coincident with the 2000-2001 abundance increases in the Sandy and Clackamas populations, a small number of coho spawners of unknown origin have been surveyed in some lower tributaries. Short- and long-term trends in productivity are below replacement. Approximately 40 percent of historical habitat is currently inaccessible, which restricts the number of areas that might support natural production, and further increases the ESU's vulnerability to environmental variability and catastrophic events. The extreme loss of naturally spawning populations, the low abundance of extant populations, diminished diversity, and fragmentation and isolation of the remaining naturally produced fish confer considerable risks to the ESU. The paucity of naturally produced spawners in this ESU is contrasted by the very large number of hatchery produced adults. The abundance of hatchery coho returning to the Lower Columbia River in 2001 and 2002 exceeded one million and 600,000 fish, respectively. The BRT expressed concern that the magnitude of hatchery production continues to pose significant genetic and ecological threats to the extant natural populations in the ESU. However, these hatchery stocks at present collectively represent a significant portion of the ESU's remaining genetic resources. The twenty-one hatchery stocks considered to be part of the ESU, if appropriately managed, may prove essential to the restoration of more widespread naturally spawning populations.

The BRT found extremely high risks for each of the VSP categories. Informed by this risk assessment, the strong majority opinion of the BRT was that the naturally spawned component of the Lower Columbia River coho ESU is "in danger of extinction" (Good et al., 2005). The minority opinion was that the ESU is "likely to become endangered within the foreseeable future."

All of the 25 hatchery programs included in the Lower Columbia River coho ESU are designed to produce fish for harvest, with two small programs designed to also augment the natural spawning populations in the Lewis River Basin. Artificial propagation in this ESU continues to represent a threat to the genetic, ecological, and behavioral diversity of the ESU. Past artificial propagation efforts imported out-of-ESU fish for broodstock, generally did not mark hatchery fish, mixed broodstocks derived from different local populations, and transplanted stocks among basins throughout the ESU. The result is that the hatchery stocks considered to be part of the ESU represent a homogenization of populations. Several of these risks have recently begun to be addressed by improvements in hatchery practices. Out-of-ESU broodstock is no longer used, and near 100-percent marking of hatchery fish is employed to afford improved monitoring and evaluation of broodstock and (hatchery- and natural-origin) returns. However, many of the within-ESU hatchery programs do not adhere to best hatchery practices. Eggs are often transferred among basins in an effort to meet individual program goals, further compromising ESU spatial structure and diversity. Programs may use broodstock that does not reflect what was historically present in a given basin, limiting the potential for artificial propagation to establish locally adapted naturally spawning populations. Many programs lack Hatchery and Genetic Management Plans that establish escapement goals appropriate for the natural capacity of each basin, and that identify goals for the incorporation of natural-origin fish into the broodstock.

NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that hatchery programs collectively mitigate the immediacy of extinction risk for the Lower Columbia River coho ESU in-total in the short term, but that these programs do not substantially reduce the extinction risk of the ESU in the foreseeable future (NMFS, 2004d). At present, within ESU hatchery programs significantly increase the abundance of the ESU in-total. Without adequate long-term monitoring, the contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. The hatchery programs are widely distributed throughout the Lower Columbia River, reducing the spatial distribution of risk to catastrophic events. Additionally, reintroduction programs in the Upper Cowlitz River may provide additional reduction of ESU spatial structure risks. As mentioned above, the majority of the ESU's genetic diversity exists in the hatchery programs. Although these programs have the potential of preserving historical local adaptation and behavioral and ecological diversity, the manner in which these potential genetic resources are presently being managed poses significant risks to the diversity of the ESU in-total. At present, the Lower Columbia River coho hatchery programs reduce risks to ESU abundance and spatial structure, provide uncertain benefits to ESU productivity, and pose risks to ESU diversity. Overall, artificial propagation mitigates the immediacy of ESU extinction risk in the short term, but is of uncertain contribution in the long term.

Over the long term, reliance on the continued operation of these hatchery programs is risky (NMFS, 2005a). Several Lower Columbia River coho hatchery programs have been terminated, and there is the prospect of additional closures in the future. With each hatchery closure, any potential benefits to ESU abundance and spatial structure are reduced. Risks of operational failure, disease, and environmental catastrophes further complicate assessments of hatchery contributions over the long term. Additionally, the two extant naturally spawning populations in the ESU were described by the BRT as being "in danger of extinction." Accordingly, it is likely that the Lower Columbia River coho ESU may exist in hatcheries only within the foreseeable future. It is uncertain whether these isolated hatchery programs can persist without the incorporation of natural-origin fish into the broodstock. Although there are examples of salmonid hatchery programs having been in operation for relatively long periods of time, these programs have not existed in complete isolation. Long-lived hatchery programs historically required infusions of wild fish in order to meet broodstock goals. The long-term sustainability of such isolated hatchery programs is unknown. It is uncertain whether the Lower Columbia River coho isolated hatchery programs are capable of mitigating risks to ESU abundance and productivity into the foreseeable future. In isolation, these programs may also become more than moderately diverged from the evolutionary legacy of the ESU, and hence no longer merit inclusion in the ESU. Under either circumstance, the ability of artificial propagation to buffer the immediacy of extinction risk over the long-term is uncertain. Informed by the BRT's findings (NMFS 2003) and our assessment of the short- and long-term effects of artificial propagation programs on the viability of the ESU, the Artificial Propagation Evaluation Workshop concluded that the Lower Columbia coho ESU in-total is "likely to become endangered in the foreseeable future" (NMFS, 2004d).

2.1.1.1.9 Columbia River Chum. The Columbia River chum ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon (March 25, 1999, 64 FR 14508). Three artificial propagation programs are considered to be part of the ESU: the Chinook River (Sea Resources Hatchery), Grays River, and Washougal River/Duncan Creek chum hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a).

Approximately 90 percent of the historical populations in the Columbia River chum ESU are extirpated or nearly so. During the 1980s and 1990s, the combined abundance of natural spawners for the Lower and Upper Columbia River Gorge, Washougal, and Grays River populations was below 4,000 adults. In 2002, however, the abundance of natural spawners exhibited a substantial increase evident at several locations in the ESU. The preliminary estimate of natural spawners is approximately 20,000 adults. The cause of this dramatic increase in abundance is unknown. Improved ocean conditions, the initiation of a supplementation program in the Grays River, improved flow management at Bonneville Dam, favorable freshwater conditions, and increased survey sampling effort may all have contributed to the elevated 2002 abundance. However, long- and short-term productivity trends for ESU populations are at or below replacement. The loss of off-channel habitats and the extirpation of approximately 17 historical populations increase the ESU's vulnerability to environmental variability and catastrophic events. The populations that remain are low in abundance, and have limited distribution and poor connectivity.

The BRT found high risks for each of the VSP categories, particularly for ESU spatial structure and diversity. Informed by this risk assessment, the majority opinion of the BRT was that the naturally spawned component of the Columbia River chum ESU is "likely to become endangered within the foreseeable future," with a minority opinion that it is "in danger of extinction" (Good et al., 2005).

There are three artificial propagation programs producing chum salmon considered to be part of the Columbia River chum ESU. These are conservation programs designed to support natural production. The Washougal Hatchery artificial propagation program provides artificially propagated chum salmon for re-introduction into recently restored habitat in Duncan Creek, Washington. This program also serves as a genetic reserve for the naturally spawning population in the mainstem Columbia River below Bonneville Dam, which can access only a portion of spawning habitat during low flow conditions. The other two programs are designed to augment natural production in the Grays River and the Chinook River in Washington. All these programs use naturally produced adults for broodstock. These programs were only recently established (1998-2002), with the first hatchery chum returning in 2002.

NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS, 2004d). The Columbia River chum hatchery programs have only recently been initiated, and are beginning to provide benefits to ESU abundance. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. The Sea Resources and Washougal Hatchery programs have begun to provide benefits to ESU spatial structure through reintroductions of chum salmon into restored habitats in the Chinook River and Duncan Creek, respectively. These three programs have a neutral effect on ESU diversity. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance and spatial structure, but have neutral or uncertain effects on ESU productivity and diversity. Informed by the BRT's findings (NMFS 2003) and our assessment of the effects of artificial propagation programs on the viability of the ESU, the Artificial Propagation Evaluation Workshop concluded that the Columbia River chum ESU in-total is "likely to become endangered in the foreseeable future" (NMFS, 2004d).

2.1.1.1.10 Hood Canal Summer-run Chum. The Hood Canal summer-run chum includes all naturally spawned populations of summer-run chum salmon in Hood Canal and its tributaries as well as populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington (March 25, 1999, 64 FR 14508). Eight artificial propagation programs are considered to be part of the ESU : the Quilcene NFH, Hamma Hamma Fish Hatchery, Lilliwaup Creek Fish Hatchery, Union River/Tahuya, Big Beef Creek Fish Hatchery, Salmon Creek Fish Hatchery, Chimacum Creek Fish Hatchery, and the Jimmycomelately Creek Fish Hatchery summer-run chum hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS, 2005a).

Adult returns for some populations in the Hood Canal summer-run chum ESU showed modest improvements in 2000, with upward trends continuing in 2001 and 2002. The recent five-year mean abundance is variable among populations in the ESU, ranging from one fish to nearly 4,500 fish. Hood Canal summer-run chum are the focus of an extensive rebuilding program developed and implemented since 1992 by the state and tribal co-managers. Two populations (the combined Quilcene and Union River populations) are above the conservation thresholds established by the rebuilding plan. However, most populations remain depressed. Estimates of the fraction of naturally spawning hatchery fish exceed 60 percent for some populations, indicating that reintroduction programs are supplementing the numbers of total fish spawning naturally in streams. Long-term trends in productivity are above replacement for only the Quilcene and Union River populations. Buoyed by recent increases, seven populations are exhibiting short-term productivity trends above replacement. Of an estimated 16 historical populations in the ESU, seven populations are believed to have been extirpated or nearly extirpated. Most of these extirpations have occurred in populations on the eastern side of Hood Canal, generating additional concern for ESU spatial structure. The widespread loss of estuary and lower floodplain habitat was noted by the BRT as a continuing threat to ESU spatial structure and connectivity. There is some concern that the Quilcene hatchery stock is exhibiting high rates of straying, and may represent a risk to historical population structure and diversity. However, with the extirpation of many local populations, much of this historical structure has been lost, and the use of Quilcene hatchery fish may represent one of a few remaining options for Hood Canal summer-run chum conservation.

The BRT found high risks for each of the VSP categories. Informed by this risk assessment, the majority opinion of the BRT was that the naturally spawned component of the Hood Canal summer-run chum ESU is "likely to become endangered within the foreseeable future," with a minority opinion that the ESU is "in danger of extinction" (Good et al., 2005).

Of the eight programs releasing summer chum salmon that are considered to be part of the Hood Canal summer chum ESU, six of the programs are supplementation programs implemented to preserve and increase the abundance of native populations in their natal watersheds. These supplementation programs propagate and release fish into the Salmon Creek, Jimmycomelately Creek, Big Quilcene River, Hamma Hamma River, Lilliwaup Creek, and Union River watersheds. The remaining two programs use transplanted summer-run chum salmon from adjacent watersheds to reintroduce populations into Big Beef Creek and Chimacum Creek, where the native populations have been extirpated. Each of the hatchery programs includes research, monitoring, and evaluation activities designed to determine success in recovering the propagated populations to viable levels, and to determine the demographic, ecological, and genetic effects of each program on target and non-target salmonid populations. All the Hood Canal summer-run chum hatchery programs will be terminated after 12 years of operation.

NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS 2004d). The hatchery programs are reducing risks to ESU abundance by increasing total ESU abundance as well as the number of naturally spawning summer-run chum salmon. Several of the programs have likely prevented further population extirpations in the ESU. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. The hatchery programs are benefiting ESU spatial structure by increasing the spawning area utilized in several watersheds and by increasing the geographic range of the ESU through reintroductions. These programs also provide benefits to ESU diversity. By bolstering total population sizes, the hatchery programs have likely stemmed adverse genetic effects for populations at critically low levels. Additionally, measures have been implemented to maintain current genetic diversity, including the use of native broodstock and the termination of the programs after 12 years of operation to guard against long-term domestication effects.

Collectively, artificial propagation programs in the ESU presently provide a slight beneficial effect to ESU abundance, spatial structure, and diversity, but uncertain effects to ESU productivity. The long-term contribution of these programs after they are terminated is uncertain. Despite the current benefits provided by the comprehensive hatchery conservation efforts for Hood Canal summer-run chum, the ESU remains at low overall abundance with nearly half of historical populations extirpated. Informed by the BRT's findings (NMFS 2003) and our assessment of the effects of artificial propagation programs on the viability of the ESU, the Artificial Propagation Evaluation Workshop concluded that the Hood Canal summer-run chum ESU in-total is "likely to become endangered in the foreseeable future" (NMFS, 2004d).

2.1.1.1.11 Upper Willamette River Steelhead. The Upper Willamette River steelhead DPS includes all naturally spawned populations of winter-run steelhead in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive) (March 25, 1999, 64 FR 14517;). Resident populations of *O. mykiss* below impassible barriers (natural and manmade) that co-occur with anadromous populations are not included in the Upper Willamette River steelhead DPS. Although there are no obvious physical barriers separating populations upstream of the Calapooia from those lower in the basin, resident *O. mykiss* in these upper basins are both phenotypically and genetically distinct and are not considered part of the DPS. Other resident populations are not considered to be part of the Upper Willamette River steelhead DPS. This DPS does not include any artificially propagated steelhead stocks that reside within the historical geographic range of the DPS. Hatchery summer steelhead occur in the Willamette Basin but are an out-of-basin stock that is not included as part of the DPS.

The BRT was encouraged by significant increases in adult returns (exceeding 10,000 total fish) in 2001 and 2002 for the Upper Willamette River steelhead DPS. The recent five-year mean abundance, however, remains low for an entire DPS (5,819 adults), and individual populations remain at low abundance. Long-term trends in abundance are negative for all populations in the ESU, reflecting a decade of consistently low returns during the 1990s. Short-term trends, buoyed by recent strong returns, are positive. Approximately one-third of the DPS's historically accessible spawning habitat is now blocked. Notwithstanding the lost spawning habitat, the DPS continues to be spatially well distributed in the DPS, occupying each of the four major subbasins (the Mollala, North Santiam, South Santiam, and Calapooia Rivers). There is some uncertainty about the historical occurrence of steelhead in the Oregon Coastal Range drainages. Coastal cutthroat trout is a dominant species in the Willamette Basin, and thus steelhead were probably not as abundant or widespread in this DPS as they are east of the Cascade Mountains. The BRT considered the cessation of the "early" winter-run hatchery program a positive sign for DPS diversity risk, but remained concerned that releases of non-native summer steelhead continue.

The BRT found moderate risks for each of the VSP categories. Based on this risk assessment, the majority opinion of the BRT was that the Upper Willamette River steelhead DPS is "likely to become endangered within the foreseeable future" (Good et al., 2005). The minority BRT opinion was that the DPS is "not in danger of extinction or likely to become endangered within the foreseeable future." There are no artificially propagated stocks of steelhead in this DPS that mitigate the BRT's assessment that the DPS is "likely to become endangered in the foreseeable future."

2.1.1.1.12 Lower Columbia River Steelhead. The Lower Columbia River steelhead DPS includes all naturally spawned populations of steelhead in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington (inclusive), and the Willamette and Hood Rivers, Oregon (inclusive). Excluded are steelhead in the upper Willamette River Basin above Willamette Falls and steelhead from the Little and Big White Salmon Rivers in Washington (August 18, 1997, 62 FR 43937). Resident populations of *O. mykiss* below impassible barriers (natural and manmade) that co-occur with anadromous populations are not included in the Lower Columbia River steelhead DPS.

Ten artificial propagation programs are considered to be part of the DPS: the Cowlitz Trout Hatchery (in the Cispus, Upper Cowlitz, Lower Cowlitz, and Tilton Rivers), Kalama River Wild (winter- and summer-run), Clackamas Hatchery, Sandy Hatchery, and Hood River (winter- and summer-run) steelhead hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the DPS (NMFS, 2005a).

Some anadromous populations in the Lower Columbia River steelhead DPS, particularly summer-run steelhead populations, have shown encouraging increases in abundance in the last two to three years. However, population abundance levels remain small (no population has a recent five-year mean abundance greater than 750 spawners). The BRT could not conclusively identify a single population that is naturally viable. A number of populations have a substantial fraction of hatchery-origin spawners, and are hypothesized to be sustained largely by hatchery production. Long-term trends in spawner abundance are negative for seven of nine populations for which there are sufficient data, and short-term trends are negative for five of seven populations. It is estimated that four historical populations have been extirpated or nearly extirpated, and only one-half of 23 historical populations currently exhibit appreciable natural production. Although approximately 35 percent of historical habitat has been lost in the range of this DPS from the construction of dams or other impassible barriers, the DPS exhibits a broad spatial distribution in a variety of watersheds and habitat types. The BRT was particularly concerned about the impact on DPS diversity of the high proportion of hatchery-origin spawners in the DPS, the disproportionate declines in the summer steelhead life history, and the release of non-native hatchery summer steelhead in the Cowlitz, Toutle, Sandy, Lewis, Elochoman, Kalama, Wind, and Clackamas Rivers.

The BRT found moderate risks in each of the VSP categories. Informed by this assessment the majority opinion of the BRT was that the naturally spawned component of the Lower Columbia River steelhead DPS is "likely to become endangered within the foreseeable future" (Good et al., 2005). The minority opinion was that the DPS is "not in danger of extinction or likely to become endangered within the foreseeable future."

All of the 10 artificial propagation programs are designed to produce fish for harvest, but several are also implemented to augment the natural spawning populations in the basins where the fish are released. Four of these programs are part of research activities to determine the effects of artificial propagation programs that use naturally produced steelhead for broodstock in an attempt to minimize the genetic effects of returning hatchery adults that spawn naturally. One of these programs, the Cowlitz River late-run winter steelhead program, is also producing fish for release into the upper Cowlitz River Basin in an attempt to re-establish a natural spawning population above Cowlitz Falls Dam.

Hatchery programs in this DPS do not substantially reduce the extinction risk of the DPS in-total (NMFS, 2004d). The hatchery programs have reduced risks to DPS abundance by increasing total DPS abundance and the abundance of fish spawning naturally in the DPS. The contribution of DPS hatchery programs to the productivity of the DPS in-total is uncertain. It is also uncertain if reintroduced steelhead into the Upper Cowlitz River will be viable in the foreseeable future, as outmigrant survival appears to be quite low. As noted by the BRT, out-of-DPS hatchery programs have negatively impacted DPS productivity. The within-DPS hatchery programs provide a slight decrease in risks to DPS spatial structure, principally through the re-introduction of steelhead into the Upper Cowlitz River Basin. The eventual success of these reintroduction efforts, however, is uncertain. Harvest augmentation programs that have instituted locally-adapted natural broodstock protocols (e.g., the Sandy, Clackamas, Kalama, and Hood River programs) have reduced adverse genetic effects and benefitted DPS diversity. Non-DPS hatchery programs in the Lower Columbia River remain a threat to DPS diversity. Collectively, artificial propagation programs in the DPS provide a slight beneficial effect to DPS abundance, spatial structure, and diversity, but uncertain effects to DPS productivity. Informed by the BRT's findings (NMFS 2003) and our assessment of the effects of artificial propagation programs on the viability of the DPS , the Artificial Propagation Evaluation Workshop concluded that the Lower Columbia River steelhead DPS in-total is "likely to become endangered in the foreseeable future" (NMFS, 2004d).

2.1.1.1.13 Middle Columbia River Steelhead. The Middle Columbia River steelhead DPS includes all naturally spawned populations of steelhead in streams from above the Wind River, Washington, and the Hood River, Oregon (exclusive), upstream to, and including, the Yakima River, Washington, excluding steelhead from the Snake River Basin (March 25, 1999, 64 FR 14517). Resident populations of *O. mykiss* below impassible barriers (natural and manmade) co-occur with anadromous populations but are not included in the Middle Columbia River steelhead

DPS.

Seven artificial propagation programs are considered part of the steelhead DPS: the Touchet River Endemic, Yakima River Kelt Reconditioning Program (in Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River), Umatilla River, and the Deschutes River steelhead hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the DPS (NMFS, 2005a).

The abundance of some natural populations in the Middle Columbia River steelhead DPS has increased substantially over the past five years. The Deschutes and Upper John Day Rivers have recent five-year mean abundance levels in excess of their respective interim recovery target abundance levels (NMFS, 2002). Due to an uncertain proportion of out-of-DPS strays in the Deschutes River, the recent increases in this population are difficult to interpret. (It is worth noting that these interim recovery targets articulate the geometric mean of natural-origin spawners to be sustained over a period of eight years or approximately two salmonid generations, as well as a geometric mean natural replacement rate greater than one). The Umatilla River recent five-year mean natural population abundance is approximately 72 percent of its interim recovery target abundance level. The natural populations in the Yakima River, Klickitat River, Touchet River, Walla Walla River, and Fifteenmile Creek, however, remain well below their interim recovery target abundance levels. Long-term trends for 11 of the 12 production areas in the DPS were negative, although it was observed that these downward trends are driven, at least in part, by a peak in returns in the middle to late 1980s, followed by relatively low escapement levels in the early 1990s. Short-term trends in the 12 production areas were mostly positive from 1990 to 2001. The continued low number of natural returns to the Yakima River (10 percent of the interim recovery target abundance level, historically a major production center for the DPS) generated concern among the BRT. However, steelhead remain well distributed in the majority of subbasins in the Middle Columbia River DPS. The presence of substantial numbers of out-of-basin (and largely out-of-DPS) natural spawners in the Deschutes River raised substantial concern regarding the genetic integrity and productivity of the native Deschutes population. The extent to which this straying is an historical natural phenomenon is unknown. The cool Deschutes River temperatures may attract fish migrating in the comparatively warmer Columbia River waters, thus inducing high stray rates. Several sources indicate that resident fish are very common in the freshwater range of the steelhead DPS, and may greatly outnumber anadromous fish.

The BRT found moderate risk in each of the VSP categories, with the greatest relative risk being attributed to the DPS abundance category. Informed by this assessment, the opinion of the BRT was closely divided between the “likely to become endangered within the foreseeable future” and “not in danger of extinction or likely to become endangered within the foreseeable future” categories.

The seven hatchery steelhead programs propagate steelhead in three of 16 populations in the DPS, and improve kelt (post-spawned steelhead) survival in one population. There are no artificial programs producing the winter-run life history in the Klickitat River and Fifteenmile

Creek populations. All of the DPS hatchery programs are designed to produce fish for harvest, although two are also implemented to augment the natural spawning populations in the basins where the fish are released. The artificial propagation programs that produce these latter two hatchery stocks in the Umatilla River (Oregon) and the Touchet River (Washington) use naturally produced adults for broodstock. The remaining programs do not incorporate natural adults into the broodstock.

NMFS' assessment of the effects of artificial propagation on DPS extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the DPS in-total (NMFS, 2004d). DPS hatchery programs may provide a slight benefit to DPS abundance. Artificial propagation increases total DPS abundance, principally in the Umatilla and Deschutes Rivers. The kelt reconditioning efforts in the Yakima River do not augment natural abundance, but do benefit the survival of the natural populations. The Touchet River Hatchery program has only recently been established, and its contribution to DPS viability is uncertain. The contribution of DPS hatchery programs to the productivity of the three target populations, and the DPS in-total, is uncertain. The hatchery programs affect a small proportion of the DPS, providing a negligible contribution to DPS spatial structure. Overall the impacts to DPS diversity are neutral. The Umatilla River program, through the incorporation of natural broodstock, likely limits adverse effects to population diversity. The Deschutes River hatchery program may be decreasing population diversity. The recently initiated Touchet River endemic program is attempting to reduce adverse effects to diversity through the elimination of the out-of-DPS Lyons Ferry Hatchery steelhead stock. Collectively, artificial propagation programs in the DPS provide a slight beneficial effect to DPS abundance, but have neutral or uncertain effects on DPS productivity, spatial structure, and diversity. Informed by the BRT's findings (NMFS 2003) and our assessment of the effects of artificial propagation programs on the viability of the DPS, the Artificial Propagation Evaluation Workshop concluded that the Middle Columbia River steelhead DPS in-total is "likely to become endangered in the foreseeable future" (NMFS, 2004d).

2.1.1.1.14 Upper Columbia River Steelhead. The Upper Columbia River steelhead DPS includes all naturally spawned populations of steelhead in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S.-Canada border (August 18, 1997, 62 FR 43937). Resident populations of O. mykiss below impassible barriers (natural and manmade) that co-occur with anadromous populations are not included in the Upper Columbia River steelhead DPS.

Six artificial propagation programs are considered part of the DPS: the Wenatchee River, Wells Hatchery (in the Methow and Okanogan Rivers), Winthrop NFH, Omak Creek, and the Ringold steelhead hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the DPS (NMFS, 2005a).

The last two to three years have seen an increase in the number of naturally produced fish in the Upper Columbia River steelhead DPS. The 1996-2001 average return through the Priest Rapids Dam fish ladder (just below the upper Columbia steelhead production areas) was approximately

12,900 total adults (including both hatchery and natural origin fish), compared to 7,800 adults for 1992-1996. However, the recent five-year mean abundances for naturally spawned populations in this DPS are only 14 to 30 percent of their interim recovery target abundance levels. Despite increases in total abundance in the last few years, the BRT was frustrated by the general lack of detailed information regarding the productivity of natural populations. The BRT did not find data to suggest that the extremely low replacement rate of naturally spawning fish (0.25-0.30 at the time of the last status review in 1998) has appreciably improved. The predominance of hatchery-origin natural spawners (approximately 70 to 90 percent of adult returns) is a significant source of concern for DPS diversity, and generates uncertainty in evaluating trends in natural abundance and productivity. However, the natural component of the anadromous run over Priest Rapids Dam has increased from an average of 1,040 (1992-1996) to 2,200 (1997-2001). This pattern however is not consistent for other production areas within the DPS. The mean proportion of natural-origin spawners declined by 10 percent from 1992-1996 to 1997-2001.

The BRT found high risk for the productivity VSP category, with comparatively lower risk for the abundance, diversity, and spatial structure categories. Informed by this risk assessment, the slight majority BRT opinion concerning the naturally spawned component of the Upper Columbia River steelhead DPS was in the “in danger of extinction” category (Good et al., 2005). The minority opinion was that the DPS is “likely to become endangered within the foreseeable future.”

Six artificial propagation programs that produce hatchery steelhead in the Upper Columbia River Basin are considered to be part of the Upper Columbia River steelhead DPS. These programs are intended to contribute to the recovery of the DPS by increasing the abundance of natural spawners, increasing spatial distribution, and improving local adaptation and diversity (particularly with respect to the Wenatchee River steelhead). Research projects to investigate the spawner productivity of hatchery-reared fish are being developed. Some of the hatchery-reared steelhead adults that return to the basin may be in excess of spawning population needs in years of high survival conditions, potentially posing a risk to the naturally spawned populations in the DPS. The artificial propagation programs included in this DPS adhere to strict protocols for the collection, rearing, maintenance, and mating of the captive brood populations. The programs include extensive monitoring and evaluation efforts to continually evaluate the extent and implications of any genetic and behavioral differences that might emerge between the hatchery and natural stocks. Genetic evidence suggests that these programs remain closely related to the naturally-spawned populations and maintain local genetic distinctiveness of populations within the DPS. HCPs (with the Chelan and Douglas Public Utility Districts) and binding mitigation agreements ensure that these programs will have secure funding and will continue into the future. These hatchery programs have undergone ESA section 7 consultation to ensure that they do not jeopardize the recovery of the DPS, and they have received ESA section 10 permits for production though 2007. Annual reports and other specific information reporting requirements are used to ensure that the terms and conditions as specified by NMFS are followed. These programs have not experienced disease outbreaks or other catastrophic losses.

NMFS' assessment of the effects of artificial propagation on DPS extinction risk concluded that hatchery programs collectively mitigate the immediacy of extinction risk for the Upper Columbia River steelhead DPS in-total in the short term, but that the contribution of these programs in the foreseeable future is uncertain (NMFS, 2004d). The DPS hatchery programs substantially increase total DPS returns, particularly in the Methow Basin where hatchery-origin fish comprise on average 92 percent of all returns. The contribution of hatchery programs to the abundance of naturally spawning fish is uncertain. The contribution of DPS hatchery programs to the productivity of the DPS in-total is uncertain. However, large numbers of hatchery-origin steelhead in excess of broodstock needs and what the available spawning habitat can support may decrease DPS productivity in-total. With increasing DPS abundance in recent years, naturally spawning hatchery-origin fish have expanded the spawning areas being utilized. Since 1996 efforts are being undertaken to establish the Wenatchee Basin programs separately from the Wells steelhead hatchery program. These efforts are expected to increase DPS diversity over time.

There is concern that the high proportion of Wells Hatchery steelhead spawning naturally in the Methow and Okanogan basins may pose risks to DPS diversity by decreasing local adaptation. The Omak Creek program, although small in size, likely will increase population diversity over time. There has been concern that the early spawning components of the Methow and Wenatchee hatchery programs may represent a risk to DPS diversity. The recent transfer of these early-run components to the Ringold Hatchery on the mainstem Columbia River will benefit the diversity of the tributary populations, while establishing a genetic reserve on the mainstem Columbia River. Collectively, artificial propagation programs in the DPS benefit DPS abundance and spatial structure, but have neutral or uncertain effects on DPS productivity and diversity. Benefits of artificial propagation are more substantial in the Wenatchee Basin for abundance, spatial structure, and diversity. Informed by the BRT's findings (NMFS 2003) and our assessment of the effects of artificial propagation programs on the viability of the DPS , the Artificial Propagation Evaluation Workshop concluded that the Upper Columbia River steelhead DPS in-total is "likely to become endangered in the foreseeable future" (NMFS, 2004d).

2.1.1.1.15 Snake River Basin Steelhead. The Snake River Basin steelhead DPS includes all naturally spawned populations of steelhead in streams in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho (August 18, 1997, 62 FR 43937). Resident populations of O. mykiss below impassible barriers (natural and manmade) that co-occur with anadromous populations are not included in the Snake River Basin steelhead DPS.

Six artificial propagation programs are considered part of the DPS: the Tucannon River, Dworshak NFH, Lolo Creek, North Fork Clearwater, East Fork Salmon River, and the Little Sheep Creek/Imnaha River Hatchery steelhead hatchery programs. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the DPS (NMFS, 2005a).

The paucity of information on adult spawning escapement for specific tributary production areas in the Snake River Basin steelhead DPS makes a quantitative assessment of viability difficult.

All of the available data series are for Oregon populations; there are no data series available for the Idaho populations which represent the majority of the DPS. Annual return estimates are limited to counts of the aggregate return over Lower Granite Dam, and spawner estimates for the Tucannon, Grande Ronde, and Imnaha Rivers. The 2001 Snake River steelhead return over Lower Granite Dam was substantially higher relative to the low levels seen in the 1990s; the recent five-year mean abundance (14,768 natural returns) is approximately 28 percent of the interim recovery target level. The abundance surveyed in sections of the Grande Ronde, Imnaha, and Tucannon Rivers was generally improved in 2001. However, the recent five-year abundance and productivity trends were mixed. Five of the nine available data series exhibit positive long- and short-term trends in abundance. The majority of long-term population growth rate estimates for the nine available series were below replacement. The majority of short-term population growth rates were marginally above replacement, or well below replacement, depending upon the assumption made regarding the effectiveness of hatchery fish in contributing to natural production.

The BRT noted that the DPS remains spatially well distributed in each of the six major geographic areas in the Snake River Basin. The BRT was concerned that the Snake River Basin steelhead "B-run" (steelhead with a 2-year ocean residence and larger body size that are believed to be produced only in the Clearwater, Middle Fork Salmon, and South Fork Salmon Rivers) was particularly depressed. The BRT was also concerned about the predominance of hatchery produced fish in this DPS, the inferred displacement of naturally produced fish by hatchery-origin fish, and the potential impacts on DPS diversity. High straying rates exhibited by some hatchery programs generated concern about the possible homogenization of population structure and diversity within the Snake River Basin steelhead DPS. Recent efforts to improve the use of local broodstocks and release hatchery fish away from natural production areas, however, are encouraging.

The BRT found moderate risk for the abundance, productivity, and diversity VSP categories, and comparatively lower risk in the spatial structure category. Informed by this risk assessment, the majority opinion of the BRT was that the naturally spawned component of the Snake River Basin steelhead DPS is "likely to become endangered within the foreseeable future." The minority BRT opinion was split between the "in danger of extinction" and "not in danger of extinction or likely to become endangered within the foreseeable future" categories.

Artificial propagation enhancement efforts occur in the Imnaha River (Oregon), Tucannon River (Washington), East Fork Salmon River (Idaho, in the initial stages of broodstock development), and South Fork Clearwater River (Idaho). In addition, Dworshak Hatchery acts as a gene bank to preserve the North Fork Clearwater River "B-run" steelhead population, which no longer has access to historical habitat due to construction of Dworshak Dam.

NMFS' assessment of the effects of artificial propagation on DPS extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk (NMFS, 2004d). Snake River Basin hatchery programs may be providing some benefit to the local target population(s), but only the Dworshak-based programs have appreciably benefitted the number of total adult spawners. The Little Sheep hatchery program is contributing to total abundance in the

Imnaha River, but has not contributed to increased natural production. The Tucannon and East Fork Salmon River programs have only recently been initiated, and have yet to produce appreciable adult returns.

The overall contribution of the hatchery programs in reducing risks to DPS abundance is small. The contribution of DPS hatchery programs to the productivity of the DPS in-total is uncertain. Most returning Snake River Basin hatchery steelhead are collected at hatchery weirs or have access to unproductive mainstem habitats, limiting potential contributions to the productivity of the entire DPS. The artificial propagation programs affect only a small portion of the DPS's spatial distribution and confer only slight benefits to DPS spatial structure. Large steelhead programs, not considered to be part of the DPS, occur in the mainstem Snake, Grande Ronde, and Salmon Rivers and may adversely affect DPS diversity. These out-of-DPS programs are currently undergoing review to determine the level of isolation between the natural and hatchery stocks and to define what reforms may be needed. Collectively, artificial propagation programs in the DPS provide a slight beneficial effect to DPS abundance and spatial structure, but have neutral or uncertain effects on DPS productivity and diversity. Informed by the BRT's findings (NMFS 2003) and our assessment of the effects of artificial propagation programs on the viability of the DPS, the Artificial Propagation Evaluation Workshop concluded that the Snake River Basin steelhead DPS in-total is "likely to become endangered in the foreseeable future" (NMFS, 2004d).

2.1.1.2 Unlisted Salmonids

2.1.1.2.1 Puget Sound Steelhead. Puget Sound steelhead were proposed for listing as a threatened species on March 29, 2006 (71 FR 15666). The geographic boundaries of this coastal steelhead DPS extend from the United States/Canada border and include steelhead in river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington. Included are river basins east of and including the Elwha River and north to include the Nooksack River. This region is in the rain shadow of the Olympic Mountains, is therefore drier than the rainforest area of the western Olympic Peninsula, and is dominated by western hemlock forests. Streams are characterized by cold water, high average flows, and a relatively long duration of peak flows that occur twice each year.

Recent genetic data provided by WDFW show that steelhead in the Puget Sound area generally form a coherent group distinct from populations elsewhere in Washington. Chromosomal studies show that steelhead from the Puget Sound area have a distinctive karyotype not found in other regions. No recent genetic comparisons have been made between Puget Sound and British Columbia steelhead; however, Nooksack River steelhead tend to differ genetically from other Puget Sound stocks, indicating a genetic transition zone in northern Puget Sound. In life history traits, there appears to be a sharp transition between steelhead populations from Washington, which smolt primarily at age two, and those in British Columbia, which most commonly smolt at age three. This pattern holds for comparisons across the Strait of Juan de Fuca as well as for comparisons of Puget Sound and Strait of Georgia populations. At the present time, therefore, evidence suggests that the northern boundary for this DPS coincides approximately with the United States/Canada border. This DPS is primarily composed of winter steelhead but includes several stocks of summer steelhead, usually in subbasins of large river systems and above seasonal hydrologic barriers.

No estimates of historical (pre-1960s) abundance specific to the Puget Sound DPS are available. Total run size for Puget Sound for the early 1980s can be calculated from estimates in Light (1987) as about 100,000 winter steelhead and 20,000 summer steelhead. Light (1987) provided no estimate of hatchery proportion specific to Puget Sound streams. For Puget Sound and coastal Washington combined, Light (1987) estimated that 70 percent of steelhead in ocean runs were of hatchery origin; the percentage in escapement to spawning grounds would be substantially lower due to differential harvest and hatchery rack returns. Recent five-year average natural escapements for streams with adequate data range from less than 100 to 7,200, with corresponding total run sizes of 550 to 19,800. Total recent run size for major stocks in this DPS was greater than 45,000, with total natural escapement of about 22,000. Of the 21 independent stocks for which adequate escapement information exists, 17 stocks have been declining and four increasing over the available data series, with a range from 18 percent annual decline (Lake Washington winter steelhead) to seven percent annual increase (Skykomish River winter steelhead). Eleven of these trends (nine negative, two positive) were significantly different from zero. The two basins producing the largest numbers of steelhead (Skagit and Snohomish Rivers) both have overall upward trends.

Hatchery fish in this DPS are widespread, spawn naturally throughout the region, and are largely derived from a single stock (Chambers Creek). The proportion of spawning escapement comprised of hatchery fish ranged from less than one percent (Nisqually River) to 51 percent (Morse Creek). In general, hatchery proportions are higher in Hood Canal and the Strait of Juan de Fuca than in Puget Sound proper. Most of the hatchery fish in this region originated from stocks indigenous to the DPS, but are generally not native to local river basins. The WDFW has provided information supporting substantial temporal separation between hatchery and natural winter steelhead in this DPS. Given the lack of strong trends in abundance for the major stocks and the apparently limited contribution of hatchery fish to production of the late run winter stocks, most winter steelhead stocks in the Puget Sound DPS appear to be naturally sustaining at this time. However, there are clearly isolated problems with sustainability of some steelhead runs in this DPS, notably Deer Creek summer steelhead (although juvenile abundance for this stock increased in 1994) and Lake Washington winter steelhead. Summer steelhead stocks within this DPS are all small, occupy limited habitat, and most are subject to introgression by hatchery fish.

NMFS concluded that the Puget Sound steelhead DPS is not presently in danger of extinction, nor is it likely to become endangered in the foreseeable future. Despite this conclusion, NMFS has several concerns about the overall health of this DPS and about the status of certain stocks within the DPS. Recent trends in stock abundance are predominantly downward, although this may be largely due to recent climate conditions. Trends in the two largest stocks (Skagit and Snohomish Rivers) have been upward. The majority of steelhead produced within the Puget Sound region appear to be of hatchery origin, but most hatchery fish are harvested and do not contribute to natural spawning escapement. NMFS is particularly concerned that the majority of hatchery production originates from a single stock (Chambers Creek). The status of certain stocks within the DPS is also of concern, especially the depressed status of most stocks in the Hood Canal area and the steep declines of Lake Washington winter steelhead and Deer Creek summer steelhead (August 9, 1996, 61 FR 41541).

2.1.1.2.2 Olympic Peninsula Steelhead. This coastal steelhead DPS occupies river basins of the Olympic Peninsula, Washington, west of the Elwha River and south to, but not including, the rivers that flow into Grays Harbor, Washington. Streams in the Olympic Peninsula are similar to those in Puget Sound and are characterized by high levels of precipitation and cold water, high average flows, and a relatively long duration of peak flows that occur twice a year. In contrast to the more inland areas of Puget Sound where western hemlock is the dominant forest cover at sea level, lowland vegetation in this region is dominated by Sitka spruce. Genetic data collected by WDFW indicate that steelhead in this region are substantially isolated from other regions in western Washington. Only limited life history information is available for Olympic Peninsula steelhead, and the information that does exist is primarily from winter-run fish. As with the Puget Sound DPS, known life history attributes of Olympic Peninsula steelhead are similar to those for other west coast steelhead, the notable exception being the difference between United States and Canadian populations in age at smolting. This DPS is primarily composed of winter steelhead but includes several stocks of summer steelhead in the larger rivers (August 9, 1996, 61 FR 41541).

No estimates of historical (pre-1960s) abundance specific to the Olympic Peninsula DPS are available. Total run size for the major stocks in the Olympic Peninsula DPS for the early 1980's can be calculated from estimates in Light (1987) as about 60,000 winter steelhead. Light (1987) provided no estimate of hatchery proportion for these streams. For Puget Sound and coastal Washington together, Light (1987) estimated that 70 percent of steelhead were of hatchery origin. Recent five-year average natural escapements for streams with adequate data range from 250 to 6,900, with corresponding total run sizes of 450 to 19,700. Total recent (1989–1993 average) run size for major streams in this DPS was about 54,000, with a natural escapement of 20,000 fish.

Of the 12 independent stocks for which adequate information existed to compute trends, seven were declining and five increasing over the available data series, with a range from eight percent annual decline to 14 percent annual increase. Three of the downward trends were significantly different from zero. Three of the four river basins producing the largest numbers of natural fish had upward trends in basinwide total numbers. Hatchery fish are widespread and escaping to spawn naturally throughout the region, with hatchery production largely derived from a few parent stocks. Estimated proportions of hatchery fish in natural spawning areas range from 16 percent (Quillayute River) to 44 percent (Quinault River), with the two largest producers of natural fish (Quillayute and Queets Rivers) having the lowest proportions. The WDFW has provided information supporting substantial temporal separation between hatchery and natural winter steelhead in this DPS. Given the lack of strong trends in abundance and the apparently limited contribution of hatchery fish to production of the late-run winter stocks, most winter steelhead stocks in the Olympic Peninsula DPS appear to be naturally sustaining at this time. However, there are clearly isolated problems with sustainability of some winter steelhead runs in this DPS, notably the Pysht/Independents stock, which has a small population with a strongly declining trend over the available data series, and the Quinault River stock, which has a declining trend and substantial hatchery contribution to natural spawning.

NMFS concluded that the Olympic Peninsula steelhead is not presently in danger of extinction, nor is it likely to become endangered in the foreseeable future (August 9, 1996, 61 FR 41541). Despite this conclusion, NMFS has several concerns about the overall health of this DPS and about the status of certain stocks within the DPS. The majority of recent trends are upward (including three of the four largest stocks), although trends in several stocks are downward. These downward trends may be largely due to recent climate conditions. There is widespread production of hatchery steelhead within this DPS, largely derived from a few parent stocks, which could increase genetic homogenization of the resource despite management efforts to minimize introgression of the hatchery gene pool into natural populations.

2.1.1.2.3 Southwest Washington Steelhead. This coastal steelhead DPS occupies the river basins of, and tributaries to, Grays Harbor, Willapa Bay, and the Columbia River below the Cowlitz River in Washington and below the Willamette River in Oregon. Willapa Bay and Grays Harbor in southwest Washington have extensive intertidal mud and sand flats and differ substantially from estuaries to the north and south. This similarity between the Willapa Bay and Grays Harbor estuaries results from the shared geology of the area and the transportation of Columbia River sediments northward along the Washington coast. Rivers draining into the Columbia River have their headwaters in increasingly drier areas, moving from west to east. Columbia River tributaries that drain the Cascade Mountains have proportionally higher flows in late summer and early fall than rivers on the Oregon coast. Recent genetic data (Leider et al., 1995) show consistent differences between steelhead populations from the southwest Washington coast and coastal areas to the north, as well as Columbia River drainages east of the Cowlitz River. Genetic data do not clearly define the relationship between southwest Washington steelhead and lower Columbia River steelhead. This DPS is primarily composed of winter steelhead but includes summer steelhead in the Humptulips and Chehalis River Basins.

No estimates of historical (pre-1960's) abundance specific to this DPS are available. Recent five-year average natural escapements for individual tributaries with adequate data range from 150 to 2,300, with the Chehalis River and its tributaries representing the bulk of production. Total recent (five-year average) natural escapement for major streams in this DPS was about 13,000. All but one (Wynoochee River) of the 12 independent stocks have been declining over the available data series, with a range from seven percent annual decline to 0.4 percent annual increase. Six of the downward trends were significantly different from zero. For Washington streams, these trends are for the late run ''wild'' component of winter steelhead populations; Oregon data included all stock components. Most of the Oregon trends are based on angler catch, and so may not reflect trends in underlying population abundance.

In general, stock condition appears to be healthier in southwest Washington than in the lower Columbia River Basin. Hatchery fish are widespread and escaping to spawn naturally throughout the region, largely from parent stocks from outside the DPS. This could substantially change the genetic composition of the resource despite management efforts to minimize introgression of the hatchery gene pool into natural populations. Estimates of the proportion of hatchery fish on natural spawning grounds range from nine percent (Chehalis, the largest producer of steelhead in the DPS) to 82 percent (Clatskanie). Available information suggests substantial temporal separation between hatchery and natural winter steelhead in this DPS; however, some Washington stocks (notably lower Columbia River tributaries) appear to have received substantial hatchery contributions to natural spawning. NMFS concluded that the Southwest Washington steelhead is not presently in danger of extinction, nor is it likely to become endangered in the foreseeable future (August 9, 1996, 61 FR 41541). Almost all stocks within this DPS for which data exist have been declining in the recent past, although this may be partly due to recent climate conditions.

NMFS is concerned about the pervasive opportunity for genetic introgression from hatchery stocks within the DPS and about the status of summer steelhead. There is widespread production of hatchery steelhead within this DPS, largely from parent stocks from outside the DPS. This could substantially change the genetic composition of the resource despite management efforts to minimize introgression of the hatchery gene pool into natural populations.

2.1.1.2.4 Unlisted Sockeye Evolutionarily Significant Units

2.1.1.2.4.1 Okanogan River. This ESU consists of sockeye salmon that return to Lake Osoyoos through the Okanogan River via the Columbia River and spawn primarily in the Canadian section of the Okanogan River above Lake Osoyoos. The BRT distinguished Okanogan River sockeye based on (1) the very different rearing conditions encountered by juvenile sockeye salmon in Lake Osoyoos, (2) the tendency for a large percentage of there-year-old returns to the Okanogan population, (3) the apparent one-month separation in juvenile run-timing between Okanogan and Wenatchee-origin fish, and (4) the adaption of Okanogan River sockeye salmon to much higher temperatures during adult migration in the Okanogan River. Protein electrophoretic data also indicate that this population is genetically distinct from other sockeye salmon currently in the Columbia River drainage (Winans et al., 1996; Wood et al., 1996; and Thorgaard et al., 1995).

Kokanee are reported to occur in Lake Osoyoos, and one known plant of 195,000 kokanee from an unknown source stock occurred in this lake in the years 1919–1920. Kokanee-sized fish, or residuals with a reportedly olive drab or ‘‘typically dark’’ coloration, respectively, have been observed spawning with sockeye in the Okanogan River. Genetic samples of kokanee-sized fish from Lake Osoyoos have not been obtained. However, kokanee from Okanogan Lake, above Vaseux Dam and Vaseux Lake on the Okanogan River, are genetically quite distinct from Okanogan River sockeye salmon (Wood et al., 1994; Thorgaard et al, 1995; Utter, 1995; Robison, 1995; and Winans et al., 1996). The BRT concluded that, if ‘‘kokanee-ized’’ *O. nerka* observed spawning with sockeye salmon on the Okanogan River are identified as resident sockeye salmon, they are to be considered part of this sockeye salmon ESU. Based on the large genetic difference between Okanagan Lake kokanee and Okanogan River sockeye salmon, the BRT decided that Okanagan Lake kokanee are not part of the Okanogan sockeye salmon ESU (Note—The accepted spelling in Canada is Okanagan, and in the United States it is Okanogan. In this document Okanagan will be used when referring to geographic features in Canada and Okanogan when referring to geographic features in the U.S.) The BRT felt that spawning aggregations of sockeye that are occasionally observed downstream from Lake Osoyoos and below Enloe Dam on the Similkameen River are most likely wanderers from the Okanogan River population and are, therefore, to be considered part of this ESU.

The major abundance data series for Okanogan River sockeye salmon consist of spawner surveys conducted in the Okanogan River above Lake Osoyoos since the late 1940s, counts of adults passing Wells Dam since 1967, and records of tribal harvest (Colville and Okanogan) since the late 1940s. Longer term data were available for dams lower on the Columbia River (notably Rock Island Dam counts starting in 1933), but these counts represent a combination of this ESU with the Wenatchee population and other historical ESUs from the upper Columbia River above Grand Coulee Dam. The five-year average annual escapement for this ESU was about 11,000 adults, based on 1992–1996 counts at Wells Dam. No historical abundance estimates specific to this ESU are available. However, analyses conducted in the late 1930s indicated that less than 15 percent of the total sockeye run in the upper Columbia River went into Lakes Osoyoos and Wenatchee (Chapman et al., 1995). At that time, the total run to Rock Island Dam averaged about 15,000, suggesting a combined total of less than 2,250 adults returning to the Okanogan River and Lake Wenatchee ESUs. Thus, abundance for the Okanogan River ESU during the late 1930s was clearly substantially lower than recent abundance. Trend estimates for this stock differ depending on the data series used, but the recent (1986–1995) trend has been steeply downward (declining at 2 to 20 percent per year); however, this trend is heavily influenced by high abundance in 1985 and low points in 1990, 1994, and 1995, which may reflect environmental fluctuations. The long-term trend (since 1960) for this stock has been relatively flat (three to plus-two percent annual change). For the entire Columbia River basin, there has been a considerable decline in sockeye salmon abundance since the turn of the century. Columbia River commercial sockeye salmon landings that commonly exceeded 1,000,000 pounds in the late 1800s and early 1900s had been reduced to about 150,000 pounds by the late 1980s (Technical Advisory Committee (TAC), 1991). Since 1988, harvest has been fewer than 3,500 fish each year. The TAC (1991) attributes this decline to habitat degradation and blockage, over-harvest, hydroelectric development, and nursery lake management practices.

The two remaining productive stocks (Okanogan and Wenatchee) occupy less than four percent of historical nursery lake habitat in the upper Columbia River basin. Both Okanogan and Wenatchee runs have been highly variable over time. For harvest purposes, these two ESUs are managed as a single unit, with an escapement goal of 65,000 adults returning to Priest Rapids Dam (TAC, 1991). This goal has been achieved only ten times since 1970 and has been met in two years between 1992 and 1996. Examination of the historical trend in total sockeye salmon escapement to the upper Columbia River shows very low abundance (averaging less than 20,000 annually) during the 1930s and early 1940s, followed by an increase to well over 100,000 per year in the mid-1950s. Since the mid-1940s, abundance has fluctuated widely, with noticeable low points reached in 1949, 1961–62, 1978, and 1994. The escapement of about 9,000 fish to Priest Rapids Dam in 1995 was the lowest since 1945, but 1996 escapement (preliminary estimate, Fish Passage Center 1996) was considerably higher, although still far below the goal. Escapement to Wells Dam (i.e., this ESU) was at its lowest recorded value in 1994, but increased in both 1995 and 1996.

Past and present artificial propagation of sockeye salmon poses some risk to the genetic integrity of this ESU. The GCFMP interbred fish from this ESU with those from adjacent basins for several years, with unknown impacts on the genetic composition of this ESU. Current artificial propagation efforts use local stocks and are designed to maintain genetic diversity, but there is some risk of genetic change resulting from domestication. There is only one record of introduction of sockeye salmon from outside the Columbia River Basin into this ESU: 395,420 mixed Quinault Lake/Rock Island Dam stock released in 1942 (Mullan, 1986). Records of kokanee transplants are most likely incomplete.

In previous assessments of this stock, Nehlsen et al. (1991) considered Okanogan River sockeye salmon to be of special concern because of ''present or threatened destruction, modification, or curtailment of its habitat or range,'' including mainstem passage, flow, and predation problems, whereas WDF and WWTIT (1993) classified this stock as of native origin, wild production, and healthy status, but WDFW (1996) suggested that this ''native'' classification will be changed to ''mixed'' in the future. Low abundance, downward trends and wide fluctuations in abundance, land use practices, and variable ocean productivity were perceived as resulting in low to moderate or increasing risk for this ESU. Other major concerns regarding health of this ESU were restriction and channelization of spawning habitat in Canada, hydro system impediments to migration, and high water temperature problems in the lower Okanogan River.

Positive indicators for the ESU were escapement above 10,000, which is probably a substantial fraction of historical abundance, and the limited amount of recent hatchery production within the ESU. Recent changes in hydro system management (increases in flow and spill in the mainstem Columbia River) and harvest management (restrictions in commercial harvest to protect Snake River sockeye salmon) were regarded as beneficial to the status of this ESU. NMFS concluded unanimously that the Okanogan River sockeye salmon ESU is not presently in danger of extinction, nor is it likely to become endangered in the foreseeable future. However, the very low returns in the three most recent years suggest that the status of this ESU bears close monitoring and its status should be reconsidered if abundance remains low (March 10, 1998, 63 FR 11750).

2.1.1.2.4.2 Lake Wenatchee. This ESU consists of sockeye salmon that return to Lake Wenatchee through the Wenatchee River via the Columbia River and spawn primarily in tributaries above Lake Wenatchee (the White River, Napeequa River, and Little Wenatchee River). Virtually all allozyme data indicate that, of the populations examined, the Lake Wenatchee sockeye salmon population is genetically very distinctive. The following constitute the genetic, environmental, and life history information in distinguishing this ESU: (1) Very different environmental conditions encountered by sockeye salmon in Lake Wenatchee compared with those in Lake Osoyoos, (2) the near absence of 3-year-old sockeye returns to Lake Wenatchee, and (3) the apparent one-month separation in juvenile run-timing between Okanogan and Wenatchee origin fish. Sockeye salmon in Lake Wenatchee were severely depleted by the early 1900s (Bryant and Parkhurst, 1950; Davidson 1966; and Fulton, 1970), with returns counted over Tumwater Dam on the Wenatchee River in 1935, 1936, and 1937 amounting to 889, 29 and 65 fish, respectively (Good et al., 2005).

The redistribution and long-term propagation of mixed Arrow Lakes, Okanogan, and Wenatchee stocks of sockeye salmon originally captured at Rock Island Dam, as well as introductions of Quinault Lake sockeye salmon stocks, may have altered the genetic make-up of indigenous sockeye salmon in the Lake Wenatchee system. However, electrophoretic analysis of current Lake Wenatchee sockeye salmon reveals little affinity among Okanogan River sockeye salmon, Quinault Lake sockeye salmon or kokanee from Lower Arrow Lake. Spawning aggregations of sockeye salmon that appear in the Entiat and Methow Rivers, and in Icicle Creek (a tributary of the Wenatchee River) were presumed by the BRT to be non-native and the result of transplants. Both the Methow and Entiat Rivers had no history of sockeye salmon runs prior to stocking (Mullan, 1986). Leavenworth National Fish Hatchery is located on Icicle Creek, and, between 1942 and 1969, more than 1.5 million sockeye salmon juveniles (of mixed Columbia, Entiat, Methow Rivers heritage) were liberated from this facility into Icicle Creek (Mullan, 1986; Chapman et al., 1995). Kokanee-sized fish with a reportedly olive drab coloration have been observed spawning with sockeye salmon in the White, Napeequa, and Little Wenatchee Rivers (LaVoy, pers. comm., 1995). More than 23 million Lake Whatcom kokanee were released in Lake Wenatchee between 1934 and 1983; however, the current genetic make-up of the Lake Wenatchee sockeye salmon population reveals little or no affinity with Lake Whatcom kokanee. Genetic samples of "kokanee-ized" fish from Lake Wenatchee have not been obtained. The BRT concluded that, if ''kokanee-ized'' *O. nerka* observed spawning with sockeye salmon on the White and Little Wenatchee Rivers are identified as resident sockeye salmon, they are to be considered part of the Lake Wenatchee sockeye salmon ESU.

The major abundance data series for Wenatchee River sockeye salmon consist of spawner surveys conducted in the Little Wenatchee River and the White River since the late 1940s, counts of adults passing Tumwater Dam (sporadic counts 1935 to present), and reconstructions based on adult passage counts at Priest Rapids, Rock Island, and Rocky Reach Dams (early 1960s to present). Longer term data are available for dams lower on the Columbia River (notably Rock Island Dam counts starting in 1933), but these counts represent a combination of this ESU with the Okanogan River ESU and other historical potential ESUs from the upper Columbia River above Grand Coulee Dam. The five-year average annual escapement for this ESU was about 19,000 adults, based on the 1992–1996 difference in adult passage counts at Priest Rapids and Rocky Reach Dams. No historical abundance estimates specific to this ESU are available. However, as discussed above for the Okanogan River ESU, abundance of the Lake Wenatchee ESU during the late 1930s was clearly substantially lower than recent abundance. The 1986–1995 trend in abundance has been downward (declining at 10 percent per year), but this trend is heavily influenced by 2 years of very low abundance in 1994 and 1995. The long-term (1961–1996) trend for this stock is flat. Escapement to this ESU in 1995 (counts at Priest Rapids Dam minus those at Rocky Reach Dam) was the lowest since counting began in 1962, but 1996 escapement was somewhat higher. Past and present artificial propagation of sockeye salmon poses some risk to the genetic integrity of this ESU. As for the Okanogan River ESU, the GCFMP interbred fish from this ESU with those from adjacent basins for several years and introduced many sockeye salmon descended from Quinault Lake stock (Mullan 1986), with unknown impacts on the genetic composition of this ESU. Current artificial propagation efforts use local stocks and are designed to maintain natural genetic diversity, but there is some risk of genetic change resulting from domestication. Hatchery raised kokanee have been released in

Lake Wenatchee, including native Lake Wenatchee stock and non-native Lake Whatcom stock (Mullan, 1986). The effect of Lake Whatcom kokanee introductions on the genetic integrity of this ESU is unknown. Previous assessments of this ESU are similar to those for the Okanogan River ESU. Nehlsen et al. (1991) considered Wenatchee River sockeye salmon to be of special concern because of ‘‘present or threatened destruction, modification, or curtailment of its habitat or range,’’ including mainstem passage, flow, and predation problems. WDF and WWTIT (1993) classified this stock as of mixed origin, wild production, and healthy status. Huntington et al. (1996) identified this stock as ‘‘healthy—Level I,’’ indicating that current abundance is high relative to what would be expected without human impacts. Low abundance, downward trends and wide fluctuations in abundance, and variable ocean productivity were perceived as resulting in low to moderate risk for the ESU.

Other major concerns regarding the health of this ESU were the effects of hatchery production, hydro system impediments to migration, and potential interbreeding with non-native kokanee on genetic integrity of the unit. Positive indicators for the ESU were escapement above 10,000 and the limited amount of recent hatchery production within the ESU. Recent changes in hydro system management (increases in flow and spill in the mainstem Columbia River) and harvest management (restrictions in commercial harvest to protect Snake River sockeye salmon) were regarded as beneficial to the status of this ESU. Based on this information, NMFS concluded that the Lake Wenatchee sockeye salmon ESU is not presently in danger of extinction, nor is it likely to become endangered in the foreseeable future. However, on the basis of extremely low abundance in the 3 most recent years, NMFS concluded that this ESU bears close monitoring and its status should be reconsidered if abundance remains low (March 10, 1998, 63 FR 11750).

2.1.1.2.4.3 Quinault Lake. This ESU consists of sockeye salmon that return to Quinault Lake and spawn in the mainstem of the upper Quinault River, in tributaries of the upper Quinault River, and in a few small tributaries of Quinault Lake itself. The BRT felt that Quinault Lake sockeye salmon deserved separate ESU status based on the unique life history characteristics and the degree of genetic differentiation from other sockeye salmon populations. The distinctive early river-entry timing, protracted adult-run timing, long three to 10-month lake-residence period prior to spawning, unusually long spawn timing, and genetic differences from other coastal Washington sockeye salmon were important factors in identifying this ESU. In addition, the relative absence of red skin pigmentation and the presence of an olive-green spawning coloration by the majority of the Quinault stock appear to be unique among major sockeye salmon stocks in Washington (Storm et al., 1990; Boyer, Jr., pers. comm., 1995), although at least two sockeye salmon stocks in British Columbia appear more green than red at spawning (Wood, 1996). The rather large genetic difference between U.S. and Vancouver Island sockeye salmon, together with the apparently unique life-history characters of Quinault Lake sockeye salmon persuaded the BRT to exclude Vancouver Island stocks from this ESU. Kokanee-sized *O. nerka* have not been identified within the Quinault River Basin.

The major abundance data series for Quinault River sockeye salmon consists of escapement estimates derived from hydroacoustic surveys conducted in Quinault Lake since the mid-1970s, supplemented with earlier estimates (beginning in 1967) based on spawner surveys. The 1991–1995 five-year average annual escapement for this ESU was about 32,000 adults, with a run size of about 39,000. Approximate historical estimates indicate escapements ranging between 20,000 and 250,000 in the early 1920s, and run sizes ranging between 50,000 and 500,000 in the early 1900s (Rounsefell and Kelez, 1938). Comparison of these estimates indicates that recent abundance is probably near the lower end of the historical abundance range for this ESU. This ESU has been substantially affected by habitat problems, notably those resulting from forest management activities in the upper watershed outside Olympic National Park. Early inhabitants of the area described the upper Quinault River as flowing between narrow, heavily wooded banks, but, by the 1920s, the river was in a wide valley with frequent course changes and much siltation and scouring of gravels during winter and spring freshets (Davidson and Barnaby, 1936; Quinault Indian Nation (QIN), 1981); resultant loss of spawning habitat in the Quinault River above Quinault Lake has continued to recent times (QIN, 1981).

While stock abundance has fluctuated considerably over time (recent escapements ranging from a low of 7,500 in 1970 to 69,000 in 1968), overall trend has been relatively flat. For the full data series (1967–1995), abundance has increased by an average of about 1 percent per year; for the 1986–1995 period, abundance declined by about 3 percent per year. Artificial propagation of sockeye salmon in the Quinault River basin has a long history. Releases have been primarily native Quinault Lake stock, although Alaskan sockeye salmon eggs were brought into the system prior to 1920. The genetic effects of this introduction are unknown. Since 1973, all releases have been of local stock, but there is some risk of genetic change resulting from unnatural selective pressures. In previous assessments, Nehlsen et al. (1991) did not identify Quinault Lake sockeye salmon as at risk, and WDF and WWTIT (1993) classified this stock as of native origin, wild production, and healthy status. All risk factors were perceived as very low or low for this ESU. However, NMFS had two concerns about the overall health of this ESU. The ESU is presently near the lower end of its historical abundance range, a fact that may be largely attributed to severe habitat degradation in the upper river that contributes to poor spawning habitat quality and possible impacts on juvenile rearing habitat in Quinault Lake. The influence of hatchery production on genetic integrity is also a potential concern for the ESU. On the positive side, NMFS noted that recent escapement averaged above 30,000; harvest management has been responsive to stock status; and recent restrictions in logging to protect terrestrial species should have a beneficial effect on habitat conditions. The NMFS concluded unanimously that the Quinault Lake sockeye salmon ESU is not presently in danger of extinction, nor is it likely to become endangered in the foreseeable future (March 10, 1998, 63 FR 11750).

2.1.1.2.4.4 Baker River. This ESU consists of sockeye salmon that return to the barrier dam and fish trap on the lower Baker River after migrating through the Skagit River. They are trucked to one of three artificial spawning beaches above either one or two dams on the Baker River and are held in these enclosures until spawning. The BRT felt that Baker River sockeye salmon are a separate ESU based on genetic, life-history, and environmental characteristics. Baker River sockeye salmon are genetically distinct from sockeye salmon populations that spawn in the lower Fraser River and are genetically distinct from all other native populations of Washington sockeye salmon. Prior to inundation behind Upper Baker Dam, Baker Lake was a typical cold, oligotrophic, well-oxygenated, glacially turbid sockeye salmon nursery lake, in contrast to other sockeye salmon systems under review, with the exception of Lake Wenatchee. The Birdsview Hatchery population on Grandy Creek in the Skagit River Basin was established from Baker

Lake sockeye salmon together with a probable mixture of Quinault Lake stock and an unknown Fraser River stock. This stock was the ultimate source for the apparently successful transplants of sockeye salmon to the Lake Washington/Lake Sammamish system in the mid-1930s to early 1940s (Royal and Seymour, 1940; Kolb, 1971). Numerous reports indicate that residual or resident sockeye salmon began appearing in Baker Lake and Lake Shannon Reservoir following the installation of Lower Baker Dam in 1925 (Ward, 1929, 1930, 1932; Ricker, 1940; and Kemmerich, 1945). A spring-time recreational kokanee fishery exists in Baker Lake, although substantial aggregations of spawning kokanee have yet to be identified. The BRT found no historical records of kokanee stocking in Baker Lake. However, approximately 40 to 100 kokanee-sized *O. nerka* spawn each year in the outlet channel that drains the two upper sockeye salmon spawning beaches at Baker Lake.

The major abundance data series for Baker River sockeye salmon consist of escapement estimates derived from counts of adults arriving at a trap below Lower Baker Dam beginning in 1926. The most recent five-year average annual escapement for this ESU was about 2,700 adults. Historical estimates indicate escapements to average 20,000 near the turn of the century, with a predam low of 5,000 in 1916 (Rounsefell and Kelez, 1938), although WDFW data suggest that the 20,000 figure is a peak value, not an average (Sprague, 1996). Comparison of these estimates indicates that recent average abundance is probably near the lower end of the historical abundance range for this ESU. However escapement in 1994 (16,000 fish) was near the turn-of-the-century average.

Currently, spawning is restricted to artificial spawning ‘‘beaches’’ at the upper end of Baker Lake (in operation since 1957) and just below Upper Baker Dam (beach constructed in 1990). Spawning on the beaches is natural, and fry are released to rear in Baker Lake. Before 1925, sockeye salmon had free access to Baker Lake and its tributaries. Lower Baker Dam (constructed 1925) created Lake Shannon and blocked access to this area, but passage structures were provided. Upper Baker Dam, completed in 1959, increased the size of Baker Lake, inundating most natural spawning habitat; this was mitigated by construction of artificial spawning beaches. In most years, all returning adults are trapped below Lower Baker Dam and transported to the artificial beaches, with no spawning occurring in natural habitat (WDF and WWTIT 1993). The only recent exception to this was in 1994, when the large number of returning adults exceeded artificial habitat capacity, and excess spawners were allowed to enter Baker Lake and its tributaries (Ames, J., pers. comm., 1995). At the time of this report, no quantitative reports regarding offspring resulting from this spawning ‘‘experiment’’ are available (WDFW 1996). The artificial nature of spawning habitat, the use of net-pens for juvenile rearing, and reliance on artificial upstream and downstream transportation pose a certain degree of risk to the ESU. These human interventions in the life cycle have undoubtedly changed selective pressures on the population from those under which it evolved its presumably unique characteristics, and thus pose some risk to the long-term evolutionary potential of the ESU. There have been continuing potential problems with siltation at the newer (lower) spawning beach (WDF and WWTIT 1993), and recent proposals to close the two upper beaches in favor of production at the lower beach would thus be likely to increase the risk of spawning failure in some years. The future use of the upper beaches is uncertain (WDFW, 1996).

Problems with operations of downstream smolt bypass systems have been documented, and there may be limitations to juvenile sockeye production due to lake productivity and interactions with other salmonids (WDF and WWTIT 1993). Infectious haematopoietic necrosis (IHN) has also been a recent problem for this stock (Sprague, pers. comm., 1995). Artificial production in this ESU began in 1896 with a state hatchery on Baker Lake; hatchery efforts at Baker Lake ended in 1933, by which time the hatchery was being operated by the U.S. Bureau of Fisheries. Current propagation efforts rely primarily on the spawning beaches and net-pen rearing. Lake Whatcom kokanee were recently introduced to Lake Shannon (Knutzen, 1995). Genetic consequences of these releases and rearing programs are unknown, but there is some risk of genetic change resulting from unnatural selective pressures. In previous assessments, Nehlsen et al. (1991) identified Baker River sockeye salmon as at high risk of extinction, and WDFand WWTIT (1993) classified this stock as of native origin, artificial production, and critical status. NMFS had several concerns about the overall health of this ESU, focusing on high fluctuations in abundance, lack of natural spawning habitat, and the vulnerability of spawning beaches to water quality problems. Large fluctuations in abundance were a substantial concern. It is also likely that this stock would go extinct if present human intervention was halted and problems related to that intervention pose some risk to the population. In particular, NMFS concluded that the proposed change in management to concentrate spawning in a single spawning beach could substantially increase risk to the population related to abundance and habitat capacity and to water quality and disease. NMFS concluded that the Baker sockeye salmon ESU is not presently in danger of extinction, nor is it likely to become endangered in the foreseeable future if present conditions continue. However, because of lack of natural spawning habitat and the vulnerability of the entire population to problems in artificial habitats, NMFS concluded that this ESU bears close monitoring and its status should be reconsidered if abundance remains low (March 10, 1998, 63 FR 11750).

2.1.1.2.4.5 Lake Pleasant. A majority of the BRT concluded that Lake Pleasant sockeye salmon constituted a separate ESU, while a minority thought that insufficient information exists to accurately describe this ESU. Allozyme data for Lake Pleasant sockeye salmon indicate genetic distinctiveness from other sockeye salmon populations. Sockeye salmon in this population enter the Quillayute River in May through September and hold in the Sol Duc River before entering Lake Pleasant, usually in early November, when sufficient water depth is available in Lake Creek. Spawning occurs on beaches from late November to early January. Kemmerich (1945) indicated that native sockeye occurred in Lake Pleasant prior to 1932 and that they were of an ‘‘individual size comparable with the size of the fish of the Lake Quinault and Columbia River runs;’’ however, sockeye salmon currently in Lake Pleasant are said to be small, no bigger than 2 to 3 pounds (0.9 to 1.4 kg) (Haymes, pers. comm., 1995). Adult male and female Lake Pleasant sockeye have an average fork length of 460 mm or less for all ages combined, which is the smallest body size of any anadromous *O. nerka* population in the Pacific Northwest. In addition, in some brood years, a majority of Lake Pleasant sockeye salmon spend 2 years in freshwater prior to migrating to sea. More than 500,000 sockeye salmon fry from Baker Lake and the Birdsview Hatchery in the Skagit River Basin were released in Lake Pleasant in the 1930s; however, electrophoretic analysis of current Lake Pleasant sockeye salmon reveals little genetic affinity with Baker Lake sockeye salmon. It is assumed that the poisoning of Lake Pleasant during ‘‘lake rehabilitation’’ activities in the 1950s and 1960s may have impacted one or two broodyears of sockeye salmon in Lake Pleasant.

Although no recent complete escapement estimates are available for this stock, NMFS recently received some spawner-survey data for the period 1987 to 1996 (Mosley, 1995; Tierney, 1997). Peak spawner counts ranged from a low of 90 (1991—a year with limited sampling) to highs above 2,000 (1987 and 1992). Abundance fluctuated widely during this period, with a slight negative trend overall. Complete counts at a trapping station on Lake Creek in the early 1960s showed escapements of sockeye salmon ranging from 763 to 1,485 fish, and 65,000 sockeye salmon smolts were reported to have outmigrated in 1958 (Crutchfield et al., 1965). This stock supports small sport and tribal commercial fisheries, with probably fewer than 100 fish caught per year in each fishery (WDF and WWTIT 1993). Sockeye salmon from Grandy Creek stock were released in 1933 and 1937; no sockeye salmon have been introduced since then. In previous assessments, Nehlsen et al. (1991) did not identify Lake Pleasant sockeye salmon as at risk, and WDF et al. (1993) classified this stock as of native origin, wild production, and unknown status. Although escapement monitoring data are sparse, escapements (represented by peak spawner counts) in the late 1980s and 1990s appear roughly comparable to habitat capacity for this small lake. Some concerns were expressed regarding potential urbanization of habitat and effects of sport harvest during the migration delay in the Sol Duc River. It was noted that recent restrictions in logging to protect terrestrial species should have a beneficial effect on habitat conditions, although little or no old growth forest is present in the watershed. NMFS concluded that there was insufficient information to adequately assess extinction risk for the Lake Pleasant ESU (March 10, 1998, 63 FR 11750).

2.1.1.2.5 Pink Salmon Evolutionarily significant Units

2.1.1.2.5.1 Even-Year Pink Salmon. A single population of even-year pink salmon occurs in the United States south of Alaska—in the Snohomish River in Washington. Genetically, this population is much more similar to even-year pink salmon from British Columbia and Alaska than it is to odd-year pink salmon from Washington. In addition, a similar pattern is found in phenotypic and life-history traits such as body size and run timing. This result is consistent with numerous studies that have found large genetic differences between even and odd-year pink salmon from the same area (e.g., Aspinwall, 1974; Beacham et al., 1985; Kartavtsev 1991). The Snohomish River even-year pink salmon population is geographically isolated by several hundred kilometers from other even-year pink salmon populations of appreciable size. However, life-history features of the Snohomish River even-year population are similar to those in other even-year populations from central British Columbia. For example, time of peak spawning of even-year pink salmon in the Snohomish River is comparable to that of even-year British Columbia pink salmon and 3–4 weeks earlier than that of odd-year pink salmon in the Snohomish River. Genetic analyses are highly dependent upon standardization between laboratories, but available data indicate that even-year Snohomish River pink salmon are among the most distinctive of any pink salmon sample from the United States or southern British Columbia.

At the present time, the Snohomish River even-year pink salmon ESU (October 4, 1995, 60 FR 51928) is relatively small, on the order of a few thousand adults per generation. In defining the term ‘‘species’’ as it applies to Pacific salmon, NMFS has previously stated that a population should not be considered an ESU if the historic size (or historic carrying capacity) is too small for it to be plausible to assume the population has remained isolated over an evolutionarily important time period (Waples 1991). The fact that small spawning populations are regularly observed may reflect the dynamic processes of extinction, straying, and recolonization (Waples 1991). Therefore, the small size of the current Snohomish River even-year pink salmon population suggests that it may be part of a larger geographic unit on evolutionary time scales (hundreds or thousands of years). The odd-year Snohomish River pink salmon population, which has the same spawning habitat available, is 1–2 orders of magnitude larger; therefore, it is possible that the even-year population was once much larger in the past. If that were the case, long-term persistence of this population in isolation would be easier to explain, since larger, isolated populations are likely to be more resilient to extinction than a small population such as this one.

2.1.1.2.5.2 Odd-Year Pink Salmon. Genetic information indicates that odd-year pink salmon from southern British Columbia and Washington are clearly in a different evolutionary lineage than nearby even-year populations and more northerly odd-year populations. Within the southern British Columbia-Washington pink salmon group, there is also evidence of geographic population genetic structure, with detectable differences among groups of populations from the Dungeness River, Hood Canal, Puget Sound, and Fraser River, and southern and central British Columbia, Canada. In some analyses, Nisqually and Nooksack River populations in Puget Sound, WA are genetic outliers not similar to each other. Even so, none of the genetic differences within the southern British Columbia-Washington pink salmon group is very large in absolute magnitude. Based on currently available information, NMFS concluded that the northern boundary of the odd-year ESU corresponds to the Johnstone Strait region of British Columbia, Canada. The ESU does not include northern British Columbia, Alaskan, or Asian populations of pink salmon. In Washington, westernmost populations in this ESU are found in the Dungeness River, but the ESU presumably would also include the Elwha River population, if a remnant still exists (see Status of West Coast Pink Salmon ESUs). Some uncertainty exists whether populations in the Dungeness River (and possibly the Elwha River in Washington and southern Vancouver Island in British Columbia) belong in a separate ESU. Further, given the uncertainty associated with the presence of populations outside this range, NMFS believes that insufficient information presently exists to determine whether other populations of pink salmon on the Olympic Peninsula or locations further south should be included in this ESU.

In considering whether these ESUs are threatened or endangered according to the ESA, NMFS evaluated both qualitative and quantitative information. Qualitative evaluations considered recent, published assessments by agencies or conservation groups of the status of pink salmon within the geographic area. Quantitative assessments were based on current and historical abundance information and time series data compiled from a variety of Federal, state, and tribal agency records.

Nehlsen et al. (1991) considered salmon stocks throughout Washington, Idaho, Oregon, and California and enumerated all stocks that they found to be extinct or at risk of extinction. Pink salmon stocks in the Klamath and Sacramento Rivers, located in California, were considered extinct. Three stocks were considered to be at high risk of extinction (Russian River, CA; Elwha River, WA; and Skokomish River, WA) and one at moderate risk of extinction (Dungeness River, WA). Pink salmon stocks that do not appear in their summary were either not considered to be at risk of extinction or there was insufficient information to classify them.

The WDF and WWTIT (1993) categorized all salmon stocks in Washington on the basis of stock origin, production type, and status (healthy, depressed, critical, or unknown). Of the 15 pink salmon stocks identified by WDF et al. (1993), nine were classified as healthy, two as critical (lower Dungeness and Elwha Rivers), two as depressed (upper Dungeness and Dosewallips Rivers), and two as unknown (North and Middle Fork Nooksack, and South Fork Nooksack River). All runs were classified as wild production and all except those in the North and Middle Forks of the Nooksack River, were reported to be of native origin. In the planned 1995 revision of the Washington State Salmon and Steelhead Inventory, the WDF intends to recommend that Elwha River pink salmon be classified as extinct since no adult fish have been observed since 1989 despite extensive annual surveys (Hard, et al, 1996). Based on available data, it is difficult to ascertain with any degree of certainty the extent of the ESU that contains the Snohomish River even-year pink salmon population. The small size of the current Snohomish River even-year population suggests that it may be part of a larger geographic unit over evolutionary time.

The Snohomish River even-year population is geographically isolated by several hundred kilometers from other even year populations of appreciable size; however, similar life history characteristics, such as time of peak spawning, are similar to that of even year British Columbia pink salmon. Results of genetic data are heavily dependent on whether an adjustment is made for possible differences in methods for recording data. Further, it is not clear which analyses should be preferred, those with or without adjustment for possible bias. Given the uncertainty associated with the extent of the even-year ESU, NMFS considered the status of this ESU under two scenarios: (1) The ESU is composed solely of the Snohomish River pink salmon population, and (2) the ESU contains populations of even-year pink salmon from British Columbia in addition to the Snohomish River population. Under both scenarios, NMFS was unable to demonstrate that this ESU is currently at risk of extinction or endangerment. Available information indicates that the Snohomish River pink salmon population is relatively small with, generally, an increasing trend in abundance in recent years. Further, even-year pink salmon populations in British Columbia are generally stable or increasing. Therefore, under both ESU scenarios, NMFS has concluded that even-year pink salmon do not presently warrant listing under the ESA.

Similar to the even-year ESU, uncertainty remains regarding the extent of the odd-year pink salmon ESU. Environmental and ecological characteristics generally show a strong north-south trend; however, NMFS was unable to identify any substantial differences that consistently differentiate Washington and British Columbia odd-year pink salmon populations. Although odd-year pink salmon show considerable variation in body size among populations in Washington, the range of variation does not exceed that found in British Columbia. Genetic information shows a clear distinction between nearby even year pink salmon and more northerly odd-year populations. Within the southern British Columbia and Washington pink salmon group, evidence of geographic population structure exists; however, none of the genetic differences is very large in absolute magnitude. Even though genetic differences among odd-year pink salmon are relatively small, the consistent genetic differences among geographically isolated groups of populations suggest that there has been some degree of reproductive isolation among pink salmon populations in this region. Most populations in the odd-year pink salmon ESU appear to be healthy, and overall abundance appears to be close to historic levels. The two most distinctive Puget Sound populations, the Nooksack and Nisqually River populations, both show non-significant trends in recent abundance. No other factors were identified by NMFS which would threaten the near-term survival of these populations. However, the two populations on the northern Olympic Peninsula (both of which occur in the Dungeness River and one of which, in the lower river, was petitioned for listing) appear to be at the greatest risk of extinction in this ESU. Nevertheless, because (1) most of the populations in this ESU are stable or increasing and (2) the two populations at greatest risk are not consistently differentiated from other populations in the ESU with regard to genetic or life history characters, NMFS concludes that the odd-year pink salmon ESU is not presently at risk of extinction or endangerment. Furthermore, NMFS concluded that the geographic boundaries of the even- and odd-year pink salmon ESUs should be regarded as provisional (October 4, 1995, 60 FR 51932). As such, these geographic boundaries are subject to revision should substantial new information become available.

Elwha River and lower Dungeness River pink salmon are part of a larger ESU that includes all odd-year pink salmon stocks in Washington as far west as the Elwha River and in southern British Columbia, Canada (including the Fraser River and eastern Vancouver Island), as far north as Johnstone Strait. Further, NMFS has identified a second ESU for pink salmon which includes even-year pink salmon residing in the Snohomish River, WA. NMFS has determined that, at the present time, neither ESU warrants listing as a threatened or endangered species. (October 4, 1995, 60 FR 51932).

2.1.1.3 Other Unlisted Species

2.1.1.3.1 North American green sturgeon (Acipenser medirostris). Green sturgeon are the most broadly distributed, wide ranging, and most marine-oriented species of the sturgeon family. Green sturgeon are believed to spend the majority of their lives in nearshore oceanic waters, bays, and estuaries. Early life-history stages (less than four years old) reside in fresh water, with adults returning to freshwater to spawn when they are more than 20 years of age and more than 130 cm in size. The green sturgeon ranges from Mexico to at least Alaska in marine waters, forages in estuaries and bays ranging from San Francisco Bay to British Columbia. Recent genetic information suggests that green sturgeon in North America are taxonomically distinct from morphologically similar forms in Asia. All of these fishes spawn in fresh water, however, several species are anadromous, spending much of their life in the ocean but migrating to fresh water to spawn.

When in marine waters, sturgeon are mostly found in bays and estuaries. Sturgeon feed primarily on bottom organisms such as worms, molluscs, and crustaceans. Sturgeon worldwide are commercially valued for caviar, meat, and other products. The life history of sturgeon makes them extremely vulnerable to overharvest and habitat degradation. Sturgeon have low rates of reproduction, have low fecundity, reproduce infrequently, have late sexual maturity, and exhibit skewed sex ratios with increasing age and size. Dams, locks, water diversions, dredging, logging and agriculture activities have imposed barriers to migration, degraded habitat, and inhibited the spawning success of various sturgeon species. Chemical pollution, overharvest, competition, hybridization, and disease are also threats to many sturgeon species. Green sturgeon historically have spawned in the Fraser, Columbia, Umpqua, Eel, S. Fork Trinity, and San Joaquin river systems, however, today they are believed to spawn only in the Sacramento River, Klamath River Basin, and possibly in the Rogue River. WDFW has investigated the possibility of green sturgeon spawning in the Chehalis River as it appears to provide adequate potential spawning habitat. Currently, there are low levels of adult harvest in Grays Harbor (into which the Chehalis River drains), but no evidence of actual spawning activities has been found (WDFW 2004).

The existing spawning populations are thought to be relatively small and they occur in river systems that have dams, water project operations, and other land use practices which potentially threatened these populations through the loss or degradation of habitat. In addition, the green sturgeon is harvested, generally as by-catch, in fisheries that occur in coastal Washington, the Columbia River, and the Klamath River. The harvest of green sturgeon in the coastal Washington and Columbia River fisheries is likely supported by the remaining spawning populations that occur in California.

Green sturgeon currently have no protection under the ESA. Two Distinct Population Segments (DPS) were identified by the Biological Review Team. In the 2002 status review, uncertainties in the structure and status of the green sturgeon population lead NMFS to add both DPS to their List of Species of Concern, and to commit to reviewing the status again in 2008 (after five years of study by federal, state and tribal agencies) (NMFS 2002). In March 2004, a U.S. District Court set aside NMFS' finding and remanded the matter back to the agency for redetermination. The two DPS are now considered candidate species, as well as species of concern. NMFS was required by the court to make a new green sturgeon status determination in 2005.

In its 2005 review, the BRT concluded that the Northern Green Sturgeon DPS was not in danger of extinction now or likely to become endangered in the foreseeable future throughout all of its range (NMFS 2005b). A majority of the likelihood votes were placed in the not being in danger of extinction now or likely to become so in the foreseeable future category while a minority of the votes were placed for becoming in danger of extinction in the foreseeable future category, and a single vote was placed in the in danger of extinction category. It should be noted that every BRT member placed at least three votes in the likely to become endangered in the foreseeable future category. This indicates the uncertainty associated with making informed risk assessments with the lack of available data and the potential for change in assessing levels of risk as more data becomes available. The majority of the BRT felt that the inclusion of two significant spawning rivers in the DPS, the continued reduction in green sturgeon catch, and improvement in data from the Rogue River were encouraging information. A minority felt that there was too much uncertainty in the green sturgeon data and that their status could be much worse than we currently think.

The entire BRT felt that the green sturgeon populations in the Northern DPS faced potentially serious threats that are particularly worrisome with the lack of data to adequately monitor population status. The BRT reiterated their previous comment that the Northern Green Sturgeon DPS should be placed on the Species of Concern list (previously the list of Candidate species), that their status be reviewed at least every five years, and that population status monitoring be implemented. The BRT compiled known threats to green sturgeon in this DPS, but were unable to rank them in importance due to lack of understanding of their impact on green sturgeon.

2.1.1.3.2 White sturgeon (Acipenser transmontanus). White sturgeon, the largest freshwater fish in North America, lives along the west coast from the Aleutian Islands to central California (Scott and Crossman 1973). Genetically similar reproducing populations inhabit three major river basins: Sacramento-San Joaquin, Columbia, and Fraser. Most white sturgeon are in the Columbia River Basin. Historically, white sturgeon inhabited the Columbia River from the mouth upstream into Canada, the Snake River upstream to Shoshone Falls, and the Kootenai River upstream to Kootenai Falls (Scott and Crossman 1973). White sturgeon also used the extreme lower reaches of other tributaries, but not extensively. Current populations in the Columbia River Basin can be divided into three groups: fish below the lowest dam, with access to the ocean (the lower Columbia River); fish isolated (functionally but not genetically) between dams; and fish in several large tributaries.

The Columbia River has supported important commercial, treaty, and recreational white sturgeon fisheries. A commercial fishery that began in the 1880's peaked in 1892 when 2.5 million kg (5.5 million lb) were harvested (Craig and Hacker 1940). By 1899 the population had been severely depleted, and annual harvest was very low until the early 1940's, but the population recovered enough by the late 1940's that the commercial fishery expanded. A 1.8-m (6-ft) maximum size restriction was enacted to prevent another population collapse. Total harvest doubled in the 1970's and again in the 1980's because of increased treaty and recreational fisheries. From 1983 to 1994, 15 substantial regulatory changes were implemented on the mainstem Columbia River downstream from McNary Dam as a result of increased fishing. Columbia River white sturgeon are still economically important. Recreational, commercial, and treaty fisheries in the Columbia River downstream from McNary Dam were valued at $10.1 million in 1992 (Tracy 1993).

White sturgeon populations in free-flowing and inundated reaches of the Columbia River Basin have been negatively affected by the abundant hydropower dams in most of the mainstem Columbia and Snake rivers (Rieman and Beamesderfer 1990). These dams have altered the magnitude and timing of discharge, water depths, velocities, temperatures, turbidities, and substrates, and have restricted sturgeon movement within the basin. Sturgeons in other river basins have declined in response to dam-induced habitat alterations (Artyukhin et al., 1978).

Abundance and growth of white sturgeon are greatest in the lower Columbia River. These fish use estuarine and marine habitats as well as riverine habitats, allowing them to feed on anadromous prey fishes (those fishes traveling upriver from the sea to spawn; Tracy 1993). Although the lower Columbia River population may be the only one in this basin that is abundant and stable, even it is at some risk of collapse (Rieman and Beamesderfer 1990). Of the 11 populations isolated between dams upstream, white sturgeon are known to be relatively abundant in only three. White sturgeon densities in three of the remaining eight populations are much lower than in the abundant populations. Data are sparse for the remaining five populations, although Zinicola and Hoines (1988) reported that in 1988 fewer than 10 white sturgeon were harvested in each of four of these impoundments and only 34 in another.

Although the lower Columbia River population probably declined during the 1980's, adoption of more restrictive harvest regulations appears to have stabilized the population (Tracy 1993). Successful spawning occurs each year in this reach (McCabe and Tracy 1993). Catch-per-unit-effort of most size groups in the three populations for which data are available declined considerably from 1987 to 1991; fisheries there have collapsed and the populations are at risk of collapse (Beamesderfer and Rien 1993). Recruitment in some populations appears limited to years with high river discharges in spring (Miller and Beckman 1993). Although most of the mainstem populations appear unstable, their genetic similarity to the stable lower Columbia River population has excluded them from consideration for listing under the federal Endangered Species Act. Overexploitation and poaching have reduced population size (Beamesderfer and Rien 1993), and impoundments and altered hydrographs caused by development of the hydropower system have altered critical spawning habitat (Parsley et al., 1993). Because the factors identified as causing declines in other white sturgeon populations are present to varying degrees in each of the other eight upstream impoundments, these populations are likely declining as well.

Current research on white sturgeon in the Kootenai River indicates that this population is unstable and declining. The USFWS listed the Kootenai River population as endangered in 1994. This population has declined to fewer than 1,000 fish, about 80percent of which are more than 20 years old. Apperson and Anders (1990) concluded that virtually no recruitment has occurred since 1974, soon after Libby Dam began regulating flows, thereby altering historical discharge patterns of the river. This altering of discharge patterns is thought to be a major causal factor limiting recruitment into this unique sturgeon population. Research on the Kootenai River is examining the effects of increased discharge on the spawning behavior of white sturgeon. During 1993 increased discharges resulted in the collection of only three white sturgeon eggs despite intensive efforts to collect early lifestages of white sturgeon (Marcuson 1994).

White sturgeon are believed to exist in small numbers in the lower three pools on the Snake River formed by Ice Harbor, Lower Monumental, and Little Goose dams (Zinicola and Hoines (1988)). Of the nine impoundments upstream from Little Goose Dam, white sturgeon are relatively abundant in two, present at low numbers in six, and are absent in another (PSMFC 1992). Although little is known about the early life history and spawning habitat requirements of white sturgeon in the Snake River, the construction and operation of the river's dams are likely to have the same effects as the impoundments on the Columbia and Kootenai rivers. White sturgeon appear more abundant in regions of the Snake River where free-flowing river habitat exists (PSMFC 1992), such as between Lower Granite and Hells Canyon dams where 76 percent of the river is free-flowing. Conversely, white sturgeon are not present in the impoundments created by Hells Canyon Dam and not abundant in the impoundment created by Oxbow Dam, which constitute two continuous slackwater regions (Welsh and Reid 1971). While free-flowing sections of the Snake River exist in varying proportions between the dams, impoundments upstream of these sections influence both water temperature and the annual discharge pattern. At least 28 sturgeon died during July 1990 because of low dissolved-oxygen levels in Brownlee Pool (PSMFC 1992). Sturgeon production in the Snake River also appears limited by dewatering from irrigation diversions (Lukens 1981) and small spawning populations (Cochnauer et al., 1985). Harvest of white sturgeon from the Snake River has had a definite negative impact on these populations, but the magnitude of the effect is unknown. Commercial fishing was permitted on the Snake River until 1943; then increasingly restrictive regulations were implemented from 1944 to 1969. In 1970 catch and release regulations were imposed on the entire river. A recommendation has been made that three of the 12 reaches of the Snake River discussed in this article be completely closed to fishing (Cochnauer et al., 1985).

Habitat changes (e.g., decreased discharges resulting in decreased spawning habitat) caused by development and operation of the hydropower system have contributed to white sturgeon population declines in the Columbia River Basin; spawning habitat has been particularly affected by dams. Overharvest of white sturgeon has caused population declines in several Columbia River Basin populations, both historically and in the past two decades. Recent management changes have helped alleviate overharvest in much of the Columbia River Basin, but refinement of management strategies is still needed in some areas. The status of the 25 Columbia River Basin white sturgeon populations varies considerably: one is stable and abundant; five are relatively abundant, but probably at lower levels than in the past; 12 are sparse and many are declining; five have unknown status but creel data suggest they are sparse; one is sparse, declining, and listed under the Endangered Species Act; and white sturgeon have probably been extirpated from another (Miller et al., 1995). Conditions that have contributed to stock declines in other white sturgeon populations are present in populations whose status is unknown, suggesting that populations with unknown status may also be declining.

2.1.1.3.3 Eulachon Smelt (Thaleichthys pacificus). Eulachon smelt annually ascend the Columbia River to spawn in the mainstem Columbia River and its tributaries downstream of Bonneville Dam. Typically, the fish enter the Columbia River in early to mid-January, followed by tributary entry in mid to late January. Smelt annually ascend the Cowlitz River, with inconsistent runs entering the Grays, Elochoman, Lewis, Kalama, and Sandy rivers. Peak tributary abundance is usually in February, with variable abundance through March, and an occasional showing in April. Smelt return to freshwater at 3, 4, and 5 years of age. Soon after freshwater entry, spawning occurs in the lower Columbia River Basin. The majority of the tributary spawning occurs in the Cowlitz River, but has been known to occur in Grays, Elochoman, Kalama, Lewis, and Sandy rivers also. Smelt are broadcast spawners preferring areas with a coarse sandy bottom. Females produce 20,000-60,000 eggs and the adults die following spawning. Eggs, which are sticky, settle to the bottom, and incubate for about 30-40 days dependent on water temperature. Young smelt larvae are about four millimeters in length and drift with the current to sea.

The smelt fishery can be traced back to the late 1800’s and landings can be used to index relative annual abundance. Fisheries are valuable in ascertaining the relative strength of the run from year to year. Catch per unit effort (CPUE) data, as measured in pounds per delivery from the commercial fishery; is valuable for describing relative variations in annual run strength.

Commercial landings and CPUE data may also be affected by environmental conditions such as water temperature. Smelt are very sensitive to variations in water temperature, with water temperatures less that 40 degrees Fahrenheit often stalling their upstream migration.

Run sizes, as indexed by commercial landings, remained relatively stable for several decades, with the exception of 1984, until landings dropped suddenly in 1993 and remained low for several years thereafter. The eruption of Mt. St. Helens severely impacted spawning in the Cowlitz River in 1980 and subsequent returns in 1984. Smelt returns in 1984 could also have been impacted by the record large El Nino event of 1982-1983. Commercial landings from 1938-1989 averaged 2.1 million pounds annually. In 1993, smelt strayed to many Washington coastal streams and bays due to cold Columbia River water temperature, as is evidenced by landings of only 500,000 pounds in the Columbia River Basin. Landings in 1994 were only 43,000 pounds and beginning in 1995, fishery restrictions were enacted. Due to reduced seasons during 1995-2000 landings are not completely comparable with previous years; however, it is apparent that the abundance of smelt in the Columbia River Basin was much reduced during 1993-2000 (ODFW and WDFW 2004).

Although total commercial landings remained low in 2000, other abundance indices suggested a significant improvement in the smelt return for 2000. Total landings were likely artificially low due to management constraints imposed on fisheries. Other abundance indices; such as (1) improved CPUE in the commercial fishery, (2) excellent sport dipping during a portion of the season, and (3) large larval abundance over wide areas during an extended period of time all suggested that the 2000 return was significantly improved in comparison to extremely poor returns of 1994-1999. The 2001 return continued the trend of increasing abundances that began in 2000 and is the first year since 1988 in which smelt returned to the Sandy River. The 2001 return, as indexed by commercial landings and CPUE data, was the largest return since 1993. Commercial fisheries in the Columbia River Basin increased in 2002, as compared to 2001, but were still far less than fishing opportunities available during 1938-1994. Total landings in 2002 were the largest since 1992 and CPUE in the Columbia River commercial fishery was the third highest on record (since1988).

The commercial landings in 2004 are the lowest since 2000, and about a tenth of the 2003 landings, despite a liberal season and favorable market. Likewise, the 2004 observed CPUE is the lowest since 2000, and less than half the 2003 observed CPUE. The good parental returns in 2000-2002 should translate into a strong 2005 smelt run. In particular, the return of three year-old fish could be very strong, given that the 2002 parental return was the highest since 1993. These direct relationships between parent and progeny are confounded by the fact that smelt have very high fecundity rates and ocean rearing conditions are likely the overriding factor in determining stock abundance for the upcoming year, as was the case in 2001-2004. It is important to note that 1999-2001 ocean conditions off the Oregon and Washington coasts were favorable for early ocean survival of juvenile smelt; however, less favorable ocean conditions have existed since 2002.

Pacific climate changes observed from late 1998 through early 2002 indicate favorable productivity in the coastal waters where eulachon migrate. These conditions, especially during the first year of ocean residency, would improve larvae-spawner survival rates. The increased eulachon returns to the Columbia River during 2001-2003 support this hypothesis; however, this relationship did not hold true during 2004. Warmer ocean conditions since late 2002 probably had greater impacts on survival of the 1999-2001 broods than anticipated. These recent unfavorable ocean conditions may have significant impacts on the survival of the 2000-2002 broods that comprise the 2005 run. Recent trends in eulachon abundance also follow another measure of ocean climate, the standardized traditional extra tropical based Southern Oscillation Index (SOI), denoted by El Nino and La Nina events. In 1977, the index changed from a regular oscillation of El Nino and La Nina anomalies to fairly persistent El Nino conditions continuing up through 1988. Eulachon returns were variable during this time. The period of 1990-1998 was dominated by extreme and persistent El Nino conditions and during this time eulachon returns saw a precipitous decline. Eulachon returns to the Columbia River remained at record low levels during 1993-2000. Beginning in 1998, La Nina conditions developed and eulachon returns began increasing in 2001 in response to improved ocean rearing conditions. The sharp decline (1993-2000) and subsequent increase (2001-2003) in spawner abundance, lag the onset of persistent El Nino and La Nina conditions by about three to four years which is the dominant life cycle of eulachon. The unfavorable El Nino condition returned in April 2001, and has persisted through 2004. This may explain the poor returns in 2004 (ODFW and WDFW 2004).

2.1.1.4 Ubiquitous Unlisted Species

Finally, shiner perch (*Cymatogaster aggregata*), Pacific staghorn sculpin (*Leptocottus armatus*), starry flounder (*Platichthys stellatus*), surf smelt (*Hypomesus pretiosus*), longfin smelt (*Spirinchus thaleichthys*), Pacific sandlance (*Ammodytes hexapteru*), and Pacific herring (*Clupea pallasii*) have no status under the ESA. Each is considered ubiquitous, and no other status data presently exists (Randy Carman, pers. comm., 2005).

2.1.2 Status of Critical Habitat

Critical habitat is defined as the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features that are essential to the conservation of the species, and which may require special management considerations or protection. Critical habitat can also include specific areas outside the geographical area outside the geographical area occupied by the species at the time it is listed that are determined by the Secretary to be essential for the conservation of the species. Endangered Species Act of 1973, as amended, section 3(5)(A).

The action area for this consultation contains designated critical habitat. In determining what areas are critical habitat, NMFS must consider those physical and biological features that are essential to the conservation of a given species (referred to as either “essential features” or “primary constituent elements”), and that may require special management considerations or protection. Such requirements include, but are not limited to: (1) Space for individual and population growth, and for normal behavior; (2) Food, water, air, light, minerals, or other nutritional or physiological requirements; (3) Cover or shelter; (4) Sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally; (5) Habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species (50 CFR 424.12(b)).

2.1.2.1 Designated Critical Habitat for Certain Snake River Salmonids

The following areas are designated critical habitat. These areas consist of the water, waterway bottom, and adjacent riparian zone of specified lakes and river reaches in hydrologic units presently or historically accessible to listed Snake River salmon (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams). Adjacent riparian zones are defined as those areas within a horizontal distance of 300 feet (91.4 m) from the normal line of high water of a stream channel (600 feet or 182.8 m, when both sides of the stream channel are included) or from the shoreline of a standing body of water (50 CFR 226.205). The complete text delineating critical habitat for each species follows.

2.1.2.1.1 Snake River Sockeye Salmon. The Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) and including all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake Rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks); Alturas Lake Creek, and that portion of Valley Creek between Stanley Lake Creek and the Salmon River. Critical habitat is comprised of all river lakes and reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams) to Snake River sockeye salmon in the following hydrologic units: Lower Salmon, Lower Snake, Lower Snake-Asotin, Lower Snake-Tucannon, Middle Salmon-Chamberlain, Middle Salmon-Panther, and Upper Salmon. Critical habitat borders on or passes through the following counties in Washington: Asotin, Benton, Clark, Columbia, Cowlitz, Franklin, Garfield, Klickitat, Pacific, Skamania, Wahkiakum, Walla, Whitman (50 CFR 226.205(a)).

2.1.2.1.2 Snake River Spring/Summer Chinook. The Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) and including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake Rivers; all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam. Critical habitat also includes river reaches presently or historically accessible (except reaches above impassable natural falls (including Napias Creek Falls) and Dworshak and Hells Canyon Dams) to Snake River spring/summer chinook salmon in the following hydrologic units: Hells Canyon, Imnaha, Lemhi, Little Salmon, Lower Grande Ronde, Lower Middle Fork Salmon, Lower Salmon, Lower Snake-Asotin, Lower Snake-Tucannon, Middle Salmon-Chamberlain, Middle Salmon-Panther, Pahsimeroi, South Fork Salmon, Upper Middle Fork Salmon, Upper Grande Ronde, Upper Salmon, Wallowa. Critical habitat borders on or passes through the following counties in Washington: Asotin, Benton, Clark, Columbia, Cowlitz, Franklin, Garfield, Klickitat, Pacific, Skamania, Wahkiakum, Walla, Whitman (50 CFR 226.205(b)).

2.1.2.1.3 Snake River Fall Chinook Salmon. The Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the

Peacock jetty (north jetty, Washington side) and including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake Rivers; the Snake River, all river reaches from the confluence of the Columbia River, upstream to Hells Canyon Dam; the Palouse River from its confluence with the Snake River upstream to Palouse Falls; the Clearwater River from its confluence with the Snake River upstream to its confluence with Lolo Creek; the North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam. Critical habitat also includes river reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams) to Snake River fall chinook salmon in the following hydrologic units; Clearwater, Hells Canyon, Imnaha, Lower Grande Ronde, Lower North Fork Clearwater, Lower Salmon, Lower Snake, Lower Snake-Asotin, Lower Snake-Tucannon, and Palouse. Critical habitat borders on or passes through the following counties in Washington: Adams, Asotin, Benton, Clark, Columbia, Cowlitz, Franklin, Garfield, Klickitat, Lincoln, Pacific, Skamania, Spokane, Wahkiakum, Walla, Whitman (50 CFR 226.205(c)).

2.1.2.2 Designated Critical Habitat for 13 other Listed Salmonid ESUs in Washington State

On September 2, 2005 (70 FR 52630), NMFS designated critical habitat for the following ESUs of salmonids in Washington State, Idaho, and Oregon: (1) Puget Sound chinook salmon, (2) Lower Columbia River chinook salmon, (3) Upper Willamette River chinook salmon, (4) Upper Columbia River spring-run chinook salmon, (5) Oregon Coast coho salmon, (6) Hood Canal summer-run chum salmon, (7) Columbia River chum salmon, (8) Ozette Lake sockeye salmon, (9) Upper Columbia River steelhead, (10) Snake River Basin steelhead, (11) Middle Columbia River steelhead, (12) Lower Columbia River steelhead, and (13) Upper Willamette River steelhead (69 FR 74572). Each of the ESUs except numbers 3, 5, and 13 are covered species under the proposed HCP. That designation was effective January 2, 2006.

The Secretary shall designate as critical habitat areas outside the geographical area presently occupied by a species only when a designation limited to its present range would be inadequate to ensure the conservation of the species (50 CFR 424.12). At the time of this consultation, the Hood Canal summer run chum salmon ESU is the only one of the above-listed ESUs for which presently unoccupied habitat was designated as critical habitat. This habitat includes approximately 8 miles (12.9 km) of unoccupied (but historically utilized) stream reaches determined to be essential for the conservation of this ESU.

Many of the ESUs addressed in this consultation share the same rivers and estuaries, have similar life history characteristics and, therefore, require many of the same PCEs. These PCEs include sites with physical features essential to the conservation of the ESU (for example, spawning gravels, water quality and quantity, side channels, forage species) because these features enable spawning, rearing, migration and foraging, behaviors essential for survival and recovery. Specific types of sites and the features associated with them include: (1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development. (2) Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage supporting juvenile development; and (iii)

Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. (3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. (4) Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. (5) Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. (6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

The designated critical habitat areas currently contain PCEs required to support the biological processes for which the species use the habitat. NMFS defined the lateral extent of designated critical habitat as the width of the stream channel defined by the ordinary high-water line as defined by the U.S. Army Corps of Engineers (COE) in 33 CFR 329.11. In areas for which ordinary high-water has not been defined pursuant to 33 CFR 329.11, the width of the stream channel shall be defined by its bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain (Rosgen, 1996) and is reached at a discharge which generally has a recurrence interval of 1 to 2 years on the annual flood series (Leopold et al., 1992). Such an interval is commensurate with nearly all of the juvenile freshwater life phases of most salmon and O. mykiss ESUs. Therefore, it is reasonable to assert that for an occupied stream reach this lateral extent is regularly "occupied." Moreover, the bankfull elevation can be readily discerned for a variety of stream reaches and stream types using recognizable water lines (e.g., marks on rocks) or vegetation boundaries (Rosgen, 1996).

In designating critical habitat in estuarine and nearshore marine areas, NMFS determined that extreme high water is the best descriptor of lateral extent of critical habitat for those areas. For nearshore marine areas we focused particular attention on the geographical area occupied by the Puget Sound ESUs (chinook and Hood Canal summer-run chum salmon) because of the unique ecological setting and well-documented importance of the area's nearshore habitats to these species. NMFS designated the area inundated by extreme high tide because it encompasses habitat areas typically inundated and regularly occupied during the spring and summer when juvenile salmon are migrating in the nearshore zone and relying heavily on forage, cover, and refuge qualities provided by these occupied habitats. While critical habitat must contain one or more PCE, this does not mean that all PCEs are present, or that the PCEs present are functioning optimally. Further detail about the condition of proposed and designated critical habitat appears in the Environmental Baseline section of this Opinion.

2.1.3 Environmental Baseline

2.1.3.1 Framework for the Description of the 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).

To describe the environmental baseline, NMFS typically depicts the environmental conditions in the action area (at the time of consultation) resulting from the effects of the variety of actions listed in the definition above. Describing those conditions together provides a basis for examining the effects of most actions during formal consultation.

To ensure the analysis is properly framed, the description of the environmental baseline must capture relevant environmental conditions at the both the time and place where the effects of the proposed action will occur. For actions consisting of a few specific activities occurring in a spatially and temporally limited span, describing the environmental baseline is usually a simple matter of depicting conditions as they exist at the time of consultation. From that depiction, the consultation biologist can simply discuss the effects of the proposed action in terms of how those conditions will change during and immediately after the proposed action, for the duration of those effects.

The present consultation differs from consultations on individual construction actions with localized, short lived effects. In contrast, instances of prescribed activities will occur at myriad locations throughout the action area, over the next 50 years. As a result, the description of the environmental baseline must depict conditions existing at the time and place FPHCP activities occur for the life of the ITP, and for some time beyond for those activities that have effects that will endure beyond the ITP term.

During consultation, NMFS considered two different methods for assessing the environmental baseline. The first was to describe existing conditions, as comprises most of what follows in this section. This description and is important because it stems from the legacy of past environmental effects that are relevant to the present status of covered species and their designated critical habitat. Additionally, since FPHCP activities will occur spread out across the action area and throughout the 50-year ITP term, NMFS also considered how to predict the on-the-ground environmental conditions that would exist when FPHCP activities occur over the 50 years following ITP issuance.

The method most frequently discussed during consultation for capturing conditions that will exist when individual actions are completed anywhere in the action area was "projecting the present baseline through time." Projecting the baseline through time involves describing the conditions as they change from present conditions, until the moment FPHCP activities are performed. Since NMFS cannot predict exactly when and where FPHCP activities (and hence, the effects of the activities) will take place, the consultation depends on a simple assumption about the stand age at which timber harvest according to the FPHCP prescriptions will occur. From that assumption, NMFS can generally describe how conditions will change after operations occur.

Since forest practices (harvest) would only occur when stands reach a certain age, NMFS developed assumption number 2 (harvest operations will occur at about 50-years stand age) stated in more detail in section 2.1.4.1.2, below. As an illustration of how this assumption is contemplated in the analysis, a unit operated under previous Forest Practices regulations in 1995 would presently be about eleven years stand age, displaying the early seral stand characteristics typical of about 78 percent of all forested streams in western Washington and 61 percent of all forested streams in eastern Washington (NMFS and USFWS 2005). Generally described, trees in early seral forests include reproduction, conifer pole, hardwood pole, and mixed pole less than 12 inches in diameter at breast height. Stand characteristics of early seral forest include everything from recently clearcut, hardwood or shrub dominated to forests with 10 to 70 percent conifer crown cover, and less than 75 percent total crown cover in hardwood trees or shrubs. The stand would also present the results of the retention requirements from the previous regulations, with very few trees retained, and typically only within the closest 30 feet or so from the stream.

According to the assumption used to support the analysis for this consultation, this example stand, being about 11 years old, would not be harvested under the FPHCP until about 2045. The analysis presumes that the stand would grow naturally, subject only to management activities to either increase the growth of desirable structural characteristics, or non-harvest management practices designed to address other watershed functional issues like sediment from roads or passage at a stream crossing. Therefore, in projecting the environmental baseline description of existing riparian forest conditions from those resulting from past and existing factors to those that will exist when harvest occurs under the FPHCP prescriptions, the analysis assumes that harvest will occur at a certain stand age and that all stands of that age will respond to the prescribed management similarly enough to generate conclusions about the effects of those practices on fish, fish habitat, and habitat function.

To depict the stand conditions that will exist when harvest occurs according to the FPHCP prescriptions, throughout the term of ITP, NMFS assumed that harvest will occur under the FPHCP at the seral stage or stand age typical of commercial harvest in Washington State. This figure varies from western to eastern Washington, but on average occurs at mid-seral stage or around 50 years stand age (NMFS and USFWS 2005). Timber size conditions typical of mid-seral stage along forested streams include conifer sawtimber, hardwood sawtimber, and mixed sawtimber from 12 to 24 inches in diameter at breast height (NMFS and USFWS 2005). Riparian forest conditions typical of mid-seral forests include forests with greater than 70 percent conifer crown cover, less than ten percent of which is from trees greater than or equal to 21 inches in diameter at breast height (Lunetta et al., 1997).

Finally, the actual condition of stands in this seral stage could vary between eastern and western Washington. Furthermore, conditions could vary depending on the regulations under which stands were previously harvested and the reproduction requirements and techniques used thereafter. However, these characteristics provide a sufficient foundation for determining how the next harvest under FPHCP prescriptions will affect the watershed functions that create and maintain fish habitat.

2.1.3.2 Biological Requirements of the Covered Species

NMFS describes the environmental baseline in terms of the biological requirements for habitat features and processes necessary to support life stages of the subject ESUs within the action area. When the environmental baseline departs from those biological requirements, the adverse effects of a proposed action on the ESU or its habitat are more likely to jeopardize the listed species or result in destruction or adverse modification of critical habitat.

The biological requirements of listed and unlisted salmon and steelhead in the action area vary depending on the life history stage present and the natural range of variation present within that system (Groot and Margolis 1991, NRC 1996, Spence et al., 1996). Each (listed or unlisted) salmonid ESU considered in this Opinion exhibits one or more life stages in the action area. Thus, for this consultation, the biological requirements for listed and unlisted salmon and steelhead are the habitat characteristics that would support successful adult spawning, embryonic incubation, emergence, juvenile rearing, holding, migration and feeding in freshwater and the nearshore marine portions of the action area.

Generally, during salmonid spawning migrations, adult salmon require clean water with cool temperatures and access to thermal refugia, dissolved oxygen near 100 percent saturation, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Anadromous fish select spawning areas based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling. Embryo survival and fry emergence depend on substrate conditions (for example gravel size, porosity, permeability, and oxygen concentrations), substrate stability during high flows, and, for most species, water temperatures of 13 degrees celsius or less. Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting. Migration of juveniles to rearing areas, whether the ocean, lakes, or other stream reaches, requires access to these habitats. Physical, chemical, and thermal conditions may all impede movements of adult or juvenile fish.

The biological requirements in the action area of white sturgeon (*Acipenser transmountanus*) vary according to location within the action area. White sturgeon are anadromous and demersal at each life stage (oriented to the bottom) with eggs being adhesive to substrate are fertilization. Spawning substrate is large smooth cobble and boulders, while adults and juveniles are found over a wide range of sediments from sandy mud to coarse sand to cobble. Spawning occurs in the spring, in areas with swift currents and appropriate substrate. Best egg development occurs in 14 to 16 degree (Celsius) water, although incubation is possible between 10 and 18 degree (Celsius) water. White sturgeon tolerate a wide range of salinity, although younger and smaller fish do not osmoregulate (adjust to varying salinity) as well as larger fish. Eggs, larvae, and small juveniles are found only in freshwater while larger juveniles are common in freshwater areas of estuaries such as Grays Harbor, Willapa Bay, and the Columbia River. They are rare in Puget Sound. Juveniles and adults feed primarily on benthic and epibenthic invertebrates, and larger white sturgeon eat other fish including euchalon. While no affirmative "migration" is identified, white sturgeon require up- and downstream passage while in freshwater, and dam construction has created isolated populations (Emmett et al., 1991).

The biological requirements of green sturgeon (*Acipenser medirostris*), vary in the action area by location and are less certain than those of white sturgeon. This species is not abundant in any Pacific coast estuary, and is probably more marine-oriented than white sturgeon, spending little time in fresh water (other than as juveniles and during the spawning life stage). Eggs, juveniles, and adults are bottom oriented (demersal), with eggs being adhesive to substrate are fertilization. Spawning substrate is probably large cobble, while juveniles and adults are found over clean sand. Juveniles require migratory passage from through freshwater to the sea during the summer and fall in after two years. They might remain near the estuary at first, but move out to nearshore waters as they grow. Adults move back into the estuary to feed and prior to spawning in riverine habitat. Green sturgeon adults are rare in Puget Sound, but common in Grays Harbor, Willapa Harbor, and the Columbia River. Primary food items are benthic invertebrates for all life stages, as well as epibenthic invertebrates and small fish for larger juveniles and adults (Emmett et al., 1991).

The biological requirements of Eulachon (*Thaleichthys pacificus*) vary in the action area by location. Adult eulachon (2 to 5 years of age) are found in inshore marine waters throughout the Pacific Ocean. They are most common in waters 80 to 200 meters deep. Eulachon are pelagic and are not associated with a particular benthic substrate or habitat type as adults, except for during periods of spawning.

Eulachon return to fresh water, generally in the lower gradient reaches of rivers, to spawn from December until March. The peak of spawning activity in Washington is in February and March (Wydoski and Whitney 2003). They deposit eggs on coarse sand sediments (McLean et al., 1999) that adhere to the substrate; spawning generally occurs at night (Wydoski and Whitney 2003). Timing is highly dependent on river conditions, as eulachon prefer to spawn in systems with strong freshets (Department of Fisheries and Oceans 2004). Eulachon use only 20 to 30 river systems on the west coast for spawning (Department of Fisheries and Oceans 2004). Spawning runs have been identified as critical predation opportunities for marine mammals and birds, especially given the high-energy content of eulachon during a time of year when the energy demands of predators are high (Sigler et al., 2004). Eulachon are thought to die after spawning, generally washing out to the ocean or being consumed locally by birds, mammals and fish, such as sturgeon (Wydoski and Whitney 2003).

Hatching occurs two to three weeks after eggs are deposited and fertilized. Once hatched, the larvae are passively washed downstream to the ocean within 24 hours (McClean et al., 1999). Though anadromous, eulachon spend no time rearing in fresh water as larvae and juveniles. They are almost immediately transported to marine waters after hatching.

Once in the marine environment, postlarval eulachon are neritic and stay near the surface of the water, feeding on copepod larvae in both the nearshore and offshore ecosystems. As they grow, juvenile eulachon develop canine-like teeth, which they loose before they are adults, the reason for which is unknown (Bartlett 1994). Prey items range from phytoplankton to copepods, Cladocera and euphausiids. They have been known to eat larvae of their own species (Hart 1973).

The biological requirements of Shiner perch (*Cymatogaster aggregata*), vary in the action area by location. Shiner perch occur in nearshore shallow-water marine, bay and estuarine habitats, both sub- and intertidally. They prefer sandy and muddy bottoms, but may be found over substrates ranging from silt-clay to boulders. They commonly associated with aquatic vegetation like eelgrass. Adults typically use intertidal eelgrass beds more at night than day. While in estuaries, juveniles and adults prefer salinity greater than eight to 10 percent, but can occur in waters that are barely to very salty (oligohaline to mesohaline). Juveniles and adults will feed on benthos or plankton, depending on prey availability (Emmett et al., 1991).

The biological requirements of Pacific staghorn sculpin (*Leptocottus armatus*) vary in the action area by location. Pacific staghorn sculpin is commonly found in estuarine environments, although it does not require this habitat type to complete its life cycle. Eggs are demersal, adhesive and probably laid in marine waters. Larvae are planktonic in marine and estuarine waters, while juveniles and adults are usually found in shallow subtidal waters, but may be found as deep as 91 meters (300 feet). They commonly burrow into the sandy mud bottoms of bays and estuaries leaving only their head and eyes exposed. They are occasionally found in the lower reaches of freshwater streams.

Spawning takes place from October through April, peaking in January and February. Spawning locations tend to be shallow coastal bays, inlets, sounds, and sloughs (Jones 1962). The species tolerates a wide range of salinities. Similarly, juveniles tolerate a wide range of water temperatures. Laboratory studies show optimum egg survival and development occurs in salinities of 26 percent and best larval survival occurs in salinities of 10.2 to 17.5 percent (Jones 1962). The spawning substrata varies from mud and sand bottoms to more firm rocky areas. Larvae are planktonic and tolerate a range of substrates from soft mud to rock. Young juveniles will settle on clean sand, and older juveniles and adults also prefer sandy habitat.

After spawning, the adults leave the shallow spawning areas for deeper offshore waters (Tasto 1975). Although no affirmative "migration" exists, small juveniles settle out in the lower marine areas of estuaries in winter and then move up into freshwater in spring. There is a tendency to move down in to the estuary as they grow (Jones 1962). The prey of Pacific staghorn sculpins includes benthic and epibenthic invertebrates, small anchovy (adults), and crustaceans (adults).

The biological requirements of starry flounder (*Platichthys stellatus*) vary in the action area depending on location. Eggs and larvae are pelagic, while juveniles and adults are demersal. Eggs are buoyant and found in nearshore marine waters; there are no substrate preferences. Larvae are planktonic and also found in nearshore marine or estuarine waters. Juveniles are found far up rivers but are estuarine dependent. Adults have been found in marine waters up to 375 meters deep. Substrate for both juveniles and adults is soft (sand, mud, gravel, but not rock).

Eggs are typically found in euhaline to polyhaline waters (18 to 40 percent salinity). Larvae are found in euhaline (30 to 40 percent salinity) water but may be found in less saline waters. Juveniles prefer mesohaline (five to 18 percent salinity), as do adults which can be found in freshwater. The species prefers water between zero and 21.5 degrees (Celsius), and temperatures over 28 degrees (celsius) are lethal.

Spawning occurs primarily in winter to early spring, near river mouths, in water less than 45 meters deep, at 11 degrees (Celsius). Starry flounder do not migrate, but do move inshore in winter (to spawn) and offshore (in summer and fall). As mentioned above, juveniles might move upriver, but are estuary dependent. Larvae are planktivorous while juveniles and adults are benthic carnivores. (Emmett et al., 1991).

The biological requirements of Surf smelt (*Hypomesus pretiosus*) vary in the action area. Eggs are benthic, and laid intertidally on beaches free of pollution and other habitat alteration (e.g. bulkheading). Spawners select substrates of coarse sand and fine gravel. Larvae, juveniles, and adults are neritic but can be found over a variety of substrates. Beaches used for spawning typically have some fresh water seepage and are usually shaded by trees or bluffs. Water temperature and salinity do not appear to affect spawning, but tide stage and time of day do. All life stages are found in estuarine and marine waters. Juveniles and adults probably migrate to estuaries seeking food and refuge from predators (Emmett et al., 1991).

The biological requirements of Pacific sandlance (*Ammodytes hexapterus*) vary in the action area. Pacific sandlance is common in the marine areas of many Pacific coast estuaries, including Puget Sound. Adults and juveniles rest and escape from predators by burrowing into clean, unconsolidated substrates. Sandlance are neritic, associated with sand bottoms less than 100 meters deep, usually in areas with high bottom currents to ensure sufficient oxygen while burrowing. Thus, sandlance biological requirements include suitable current velocities and appropriate substrate, often found at the mouth of estuaries. The species is primarily marine. Larvae are found over a variety of substrates, in full seawater to near freshwater seeps over sandy bottoms. All life stages are planktivorous feeders. Predation is identified as importantly influencing populations of sandlance, so safety or refugia from predation is a biological requirement. (Emmett et al., 1991).

The biological requirements of Pacific herring (*Clupea pallasii*) vary in the action area. Adult herring use the water column habitat in nearshore and offshore ecosystems in both coastal and inland waters (Stout et al., 2001). Spawning adults use unconsolidated nearshore habitats in the form of intertidal and shallow subtidal beaches vegetated with eelgrass and macroalgae on which eggs are deposited. Herring deposit transparent, adhesive eggs on intertidal and shallow subtidal (generally above minus 3 meters mean lower low water) eelgrass and marine algae. Marine birds heavily consume herring eggs after deposition on marine vegetation. Most Washington State herring stocks spawn from late January through early April (Washington Fish and Wildlife 1997). However, the Cherry Point stock spawns from early April through early June.

Larvae are planktonic and use the shallow waters (less than 10 to 20 meters) over the intertidal and shallow subtidal zones while growing. Juvenile herring use the same ecosystem and habitats as adults after metamorphosis.

Herring, in general, are primary and secondary consumers in all their habitats and are a critical "keystone species" with trophic links to a large number of other marine biota. Adult and larval

Pacific herring feed and depend on phytoplankton and zooplankton, especially crustaceans (e.g., copepods and decapod and barnacle larvae) and a variety of other prey items such as protozoans, diatoms, molluscan larvae, euphausids, and larval fish (Lassuy 1989; WDFW 1997).

2.1.3.3 Past and Present Land Uses

To assess the environmental baseline for this consultation, NMFS examined the effects of patterns of land use and land use change in Washington State, including the present pattern of ownership and management for land within the action area. This section summarizes that information relevant to the present environmental conditions on those lands. To prepare this summary, NMFS relied on the regional structure, presented in EIS Appendix A, to describe the environmental baseline by regions. The regions consist of logically grouped WRIAs. This assessment also summarizes other Federal actions that have undergone ESA section 7 consultation within these groups of WRIAs since 1999 when NMFS began consulting on most of the listed salmonids covered by the proposed ITP.

Federal lands cover about 30 percent of the State and are dominant in the mountainous regions. Slightly more than one-third of the Federal land (11 percent of the State) is protected in National Wilderness Areas, National Parks, and National Wildlife Refuges. The majority of the remaining Federal land is in National Forest, and managed under the Northwest Forest Plan (USDA and USDI 1994).

State lands cover about 10 percent of Washington. The vast majority of these lands (about eight percent of the State) are managed by Washington DNR. Most of the remainder is in State Wildlife Areas and State Parks. Counties and cities ownership accounts for less than one percent of the State. Tribal lands cover about seven percent. The remaining 53 percent of the lands are privately owned.

The major factors influencing present environmental conditions in Washington State include land use change from rural to urban and industrial uses; diking, channelizing, hydropower development, and water withdrawals along rivers; forest management and associated road development; development of highways and road systems throughout the State; and mining activities. These factors affecting the environmental baseline have occurred, with differences among the analysis regions and between the west and east sides of the State.

In western Washington, 83 percent of the land is presently forested, five percent is agricultural lands, four percent urban-industrial lands, and the remaining 8 percent are undeveloped, non-forested (water, wetlands, ice/snow and bare rock, and shrub and grassland). Most land use development is concentrated around Puget Sound and along the major river systems. In contrast, eastern Washington is 36 percent forested; 26 percent agricultural; 35 percent scrubland and grassland; one percent urban-industrial; and the remaining three percent water consists of wetlands, ice/snow, and bare rock. Major hydroelectric and irrigation developments along the Columbia River system heavily influence the environment in eastern Washington.

Development and land use in Washington State is historically related to the human population dynamics. Washington State's population grew by 21 percent from 1990 to 2000 and is projected to continue to grow at a fairly rapid rate over the next 20 years (Washington Office of Financial Management 2004). For the cumulative effects analysis of this consultation, NMFS assumes that increasing population will cause continued urban and industrial development, including conversion of forest ownerships to non-forested land use.

Approximately 62 percent of western Washington forests are subject to Washington Forest Practices Rules. A portion of these lands are also managed under HCPs governing forest management activities. For example, most of the State forestlands in western Washington are managed under the State Trust Lands HCP (12 percent of the west side forests) (Washington DNR 1997d), and a portion of the private lands (three percent of west side forests) and city/county lands (one percent of west side forests) are managed under individual HCPs, each summarized below. Thus, approximately 15 percent of west side forests are covered under existing HCPs. In eastern Washington, about 34 percent of the forestland is subject to Washington Forest Practices Rules and consist of State lands (seven percent), private lands (26 percent), and a very small amount of city/county lands (much less than one percent). Of the 34 percent of eastside forests subject to Washington Forest Practices Rules, about 10 percent (three percent of eastside forests) are covered under existing HCPs.

The present condition of most forestlands and associated riparian areas in Washington State is a function of historic timber harvest, associated road construction activities, and many other activities. These activities occurred for more than a century before the first environmental restrictions emerged in Washington. Prior to the adoption of the Washington Forest Practices Act in 1974, there were no rules or regulations that protected public resources from the impacts of forest practices on State and private forests. The Washington Forest Practices Rules have become incrementally more restrictive since 1974, culminating with the current Washington Forests Practices Rules adopted in 2001. Increased scientific knowledge, among other changes, have motivated this regulatory evolution. As a result of this progression, the condition of riparian areas on State and private lands is now dominated by early and mid-seral vegetation. These riparian conditions provide varying levels of the habitat function related to structure in the form of shade, bank stability, woody debris recruitment, detrital inputs, and sediment retention.

Similarly, extensive road development and harvest on unstable slopes, have resulted in ubiquitous sediment-related impacts in many watersheds, on various salmonid life histories including spawning, rearing-feeding, and migrating-feeding. The effects of conversion, agricultural uses, hydropower development (and other disruption of instream flow), and other land uses have combined with the past effects of forest practices, decreasing the function of riparian and other related habitat systems on forestlands.

2.1.3.3.1 Federal Land Management/ Northwest Forest Plan. The Northwest Forest Plan (Plan) was implemented in 1994, presenting an ecosystem approach to forest management, and covering approximately 24 million acres of Federal forestland in western Washington, western Oregon, and northern California (USDA and USDI 1994).

Approximately seven million acres of Federal forestland are managed in accordance with the Northwest Forest Plan in Washington State (FEMAT 1993) (USDA and USDI 1994). This represents about 30 percent of all forestlands. The breakdown of lands within the Northwest

Forest Plan by acres within each area and percent of total lands within the Northwest Forest Plan is:

• Congressional Reserves – 4.2 million acres, or 60 percent

• Managed and Late-Successional Reserves – 1.5 million acres, or 22 percent

• Adaptive Management Areas – 292,000 acres, or four percent

• Administratively Withdrawn Areas – 250,100 acres, or four percent

• Riparian Reserves – 232,300 acres, or three percent

• Matrix Lands – 465,000 acres, or seven percent

The majority of Washington forestland under the Northwest Forest Plan is protected in reserves and is not available for forest management activities or harvest. Silvicultural treatments are limited to those that foster older forest stand conditions on lands within Managed and Late-Successional Reserves. Commercial timber harvest occurs primarily within the Matrix Lands, or on only 7 percent of the lands under the Northwest Forest Plan in Washington State. There are additional protection measures in place on these lands that further restrict timber harvest, such as a 15 percent green tree retention requirement and special protection for sensitive species habitat and wildlife needs (FEMAT 1993).

2.1.3.3.2 State Actions and Programs. Washington DNR State Trust Lands HCP. The largest HCP in Washington is the Washington DNR State Trust Lands HCP (WDNR 1997d). The multi-species HCP, one of the most comprehensive HCPs in the Nation, covers approximately 1.6 million acres of State trust land. The HCP covers all Washington DNR-managed forestlands within the range of the northern spotted owl. This includes all of the western part of the State as well as lands on the east slopes of the Cascade Range, covering approximately seven percent of all forestlands in Washington State. The HCP minimizes and mitigates the effects of incidental take of all federally listed species within the range of the northern spotted owl, including the following listed species: northern spotted owl, marbled murrelet, Oregon silverspot butterfly, Aleutian Canada goose, peregrine falcon (which has since been federally delisted), bald eagle, gray wolf, grizzly bear, and the Columbia white-tailed deer. The HCP also provides protection for 39 additional species, including various mollusks, arthropods, fish species (including all federally listed salmon, steelhead, and native trout), amphibians, reptiles, birds, and mammals (WDNR 1997d; USFWS 2003).

The State Trust Lands HCP includes a riparian conservation strategy to protect salmonid habitat in western Washington (WDNR 1997d). The RMZ prescriptions consist of an inner riparian buffer and an outer wind buffer where needed. The primary purpose of the riparian buffer is to maintain or restore salmonid freshwater habitat and to contribute to the conservation of other aquatic and riparian-associated species, while the function of the wind buffer is to protect the riparian buffer (WDNR 1997d, p. 56). The State Trust Lands HCP also includes measures that address wetlands, unstable slopes, roads, and rain-on-snow hydrology. The Washington DNR

State Trust Lands HCP would continue to protect listed species in the State of Washington through compatible resource management. The Washington DNR State Trust Lands HCP defers to the Forest Practices Act and Rules for road construction, maintenance, and abandonment requirements.

Washington Department of Fish and Wildlife Hydraulic Project Approvals. The 1949 Hydraulic Code (RCW Chapter 75.20.100-160) gives regulatory authority to WDFW to issue an HPA for any construction activity in or near State waters. An HPA is also required for work that will use, divert, obstruct, or change the natural flow or bed of any waters of the State. The purpose of the law is to ensure that any construction carried out in or near waters, has minimal adverse impact to Washington State's fish, shellfish, and their habitat (WDFW 2003). The HPA may include site-specific mitigation measures. An HPA is required for forest practices involving activities in or near many State waters. Examples of forestry activities in or near streams that may require a HPA include, but are not limited to felling and yarding timber, the construction or repair of culverts and bridges, placement of LWD, dredging, debris removal, changes in channel structure, and the placement of outfall structures (WDFW 2003).

Comprehensive Watershed Planning Act. The 1998 Comprehensive Watershed Planning Act complements the Salmon Recovery Act by providing for locally led, cooperative efforts to assess water resource needs and by developing effective solutions on a WRIA (or watershed) basis. These watershed plans assist the State's overall efforts to manage growth, protect threatened and endangered salmon runs, and improve water quality. The plans encourage the integration of existing laws, rules, or ordinances that protect, restore, or enhance fish habitat, including the Washington Forest Practices Rules (RCW 90.82.100).

2.1.3.3.3 Private and Local Government Habitat Conservation Plans. Several private timber companies and local government entities have completed HCPs that include provisions managing the habitat of aquatic species. Most of the HCPs prepared in Washington address issues concerning multiple listed wildlife and/or aquatic species. Through cooperation with USFWS and NMFS, the plans allow for management of lands for various uses while ensuring the conservation and protection of threatened and endangered salmon, trout, and steelhead species. The following forest land HCPs represent efforts across the State to maintain compliance with the ESA while continuing land management activities.

- Green Diamond Resource Company (formerly Simpson Resource Company) has an HCP for operations on 261,575 acres of forestland in Grays Harbor, Mason, and Thurston Counties in western Washington. The HCP provides coverage for 24 species, among them a number of aquatic species including chinook, chum, and coho salmon, bull trout, coastal cutthroat trout, and steelhead (USFWS 2003). Aquatic resource protection is based on 49 different geomorphological stream channel classifications.

- Plum Creek Timber Company implements an HCP for bull trout and 25 other species on 169,177 acres of its lands along the Interstate-90 corridor between Seattle and Ellensburg (Plum Creek 1996). The Plum Creek Timber HCP includes a riparian management strategy that consists of five parts: 1) compliance with the Washington Forest Practices

Rules, 2) Watershed Analysis, 3) maintenance and protection of over 12,000 acres of riparian habitat areas and wetlands, 4) deferred harvest on stream segments listed as impaired on the Clean Water Act 303(d) list and Wetland Management Zones, and 5) an aquatic resources monitoring program (Plum Creek 1996, p. 259).

- West Fork Timber HCP (formerly Murray Pacific) covers multiple terrestrial and aquatic species including bull trout on 53,527 acres in Lewis County (USFWS 2003). The HCP calls for the creation and maintenance of riparian buffers and no-harvest zones. It also calls for road maintenance and abandonment in accordance with the Washington Forest Practices Rules (Murray-Pacific 1995).

- Port Blakely HCP covers the 7,486-acre Robert B. Eddy Tree Farm in Grays Harbor and Pacific Counties. The HCP covers multiple terrestrial and aquatic species including bull trout, coastal tailed frog, Cascades frog, and Van Dyke’s salamander.

Two local governments, the City of Seattle and Tacoma Water, have HCPs for watershed operation and maintenance within their jurisdictions:

- The City of Seattle manages the Cedar River Watershed HCP for 77 species, including bull trout, on 90,545 acres in King County (City of Seattle 1998). The HCP includes a number of riparian and aquatic strategies, including commitments to eliminate timber harvest for commercial purposes on all land and to set aside that land into an ecological reserve; to commit approximately $27.2 million for a fish and wildlife habitat restoration program; and to remove approximately 38 percent of the forest roads within the watershed in the first 20 years of the HCP (City of Seattle 1998).

- The Tacoma Water HCP stretches over 15,000 acres of the Green River Watershed and provides protection for 30 species including chum, sockeye, and Chinook salmon, coastal cutthroat trout, steelhead, and bull trout. Cumulatively, the proposed action and private and local government HCPs would continue to protect listed species in the State of Washington through compatible resource management. As stated above, the objectives of private and local government HCPs are generally to allow for the management of lands for various uses while ensuring the conservation and protection of threatened and endangered salmon, trout, and steelhead species.

2.1.3.3.4 Activities under Approved ESA section 4(d) Special Rules. In July 2000, NMFS adopted a rule affecting 12 ESUs of threatened salmonids in Washington State (July 10, 2000, 65 FR 42422). The so-called “4(d) Rule” included possible 13 limits on the definition of prohibited take, including five for habitat-affecting programs that could be found to be carried out in a way that contribution to the conservation of the subject species. Local governments were encouraged to examine their jurisdictional programs for activities they permitted or carried out that could be conducted in way comporting with the intent of those limits. In Washington, 25 local government road maintenance agencies, including that of the State of Washington, prepared a Regional Road Maintenance Program (RRMP) that became a qualified program under the 4(d) Rule in 2003.

Subsequently, six additional local road maintenance agencies joined the original 25 as implementers of the RRMP. While there might be very little cross over between RRMP activities and roads and forestry management under the State Forest Practices Act, RRMP-covered activities have been found to address the effects of road maintenance activities in a way that comports with conservation of the affected ESUs of salmonids. Furthermore, activities carried out under the RRMP will occur within the action area. Therefore, these actions influence the condition of the environmental baseline now, and will continue to affect the action area for the foreseeable term of the requested incidental take permit.

2.1.3.4 Existing Conditions Relevant to the Biological Requirements of Covered Species

Generally, the environment for listed species in the Columbia River Basin (CRB), including those species that migrate past or spawn upstream from the action area, has been dramatically affected by the development and operation of the Federal Columbia River Power System (FCRPS). Hydroelectric dams, including the two that border the action area, have eliminated mainstem spawning and rearing habitat, and have altered the natural flow regime of the Columbia River, decreasing spring and summer flows, increasing fall and winter flows, and altering natural thermal patterns. Power operations cause fluctuation in flow levels and river elevations, affecting fish movement through reservoirs, disturbing riparian areas and possibly stranding fish in shallow areas as flows recede. The two dams that define that portion of the action area cause effects similar to other dams in the migration corridor of the Columbia River, killing or injuring a portion of the smolts passing through the area. Above, below, and within the action area, the low velocity movement of water through the reservoirs behind the dams slows the smolts' journey to the ocean and enhances the survival of predatory fish (Independent Scientific Group 1996, National Research Council 1996). Similarly, within and outside of the action area, formerly complex mainstem habitats in the Columbia River have been reduced, for the most part, to single channels, with floodplains reduced in size, and off-channel habitats eliminated or disconnected from the main channel (Sedell and Froggatt 1984; Coutant 1999). The amount of LWD in the Columbia River has declined, reducing habitat complexity and altering the river's food webs (Maser and Sedell 1994). More detail on the baseline conditions within the Columbia River basin is provided in the analysis of affected WRIAs, below.

2.1.3.4.1 San Juan Islands Watershed Resource Inventory Areas. WRIAs 2 and 6 include area in San Juan and Island Counties (San Juan WRIA 2, and Island WRIA 6). These two WRIAs have little freshwater habitat, but have considerable nearshore habitat. Island County is the second smallest but second fastest growing county in Washington State. Lands zoned for forest management (44.5 square kilometers) and agriculture (18.6 square kilometers) comprise 12 percent of Island County land. About 55 percent of those lands have been developed. Leaking septic tanks have affected water quality (WSCC 2000a). No action agency has requested formal interagency consultation for proposed actions occurring in this analysis region since the listing of Puget Sound Chinook in 1999. The effects of past and present actions in these WRIAs can be relevant to nearshore marine life history North Puget Sound populations of Puget Sound Chinook and other salmonids, as well as the unlisted non-Salmonids addressed in this consultation. The only exceptions might be both species of sturgeon. There are no Puget Sound chinook populations which utilize the freshwater habitat in these WRIAs.

2.1.3.4.1.1 Hydrology. These WRIAs have no major rivers and has a relatively low stream density. Approximately 497 stream miles occur on lands subject to forest practices rules. This represents 49 percent of all streams in this area. Approximately 340 miles or 68 percent of the 497 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre eligible forest landowner parcels in this region is estimated to be less than one percent (Rogers 2003).

Most of WRIA 6 streams are intermittent or ephemeral, and generally do not provide a sufficient flow of water to support salmonids. A few streams on Whidbey Island (Maxwelton and Glendale Creeks) are presumed to flow year-around and to support small populations of resident salmonids. These perennial streams are fed by year-around springs and forested wetlands. Ten more sub-basins have been identified as having the potential to provide salmonid habitat. Coho and chum are known to occur in freshwater streams on Whidbey Island.

2.1.3.4.1.2 Habitat

Land cover and use. Forestland makes up approximately 73 percent of these WRIAs. It is more prevalent in the San Juan WRIA (78 percent) than in the Island WRIA (69 percent). Agricultural uses make up approximately 17 percent of the region, and are about equally prevalent in the two WRIAs. Residential and commercial uses make up the next largest percentage (6 percent), with more development in the Island WRIA and less in the San Juan WRIA. An analysis for road density in the region yielded an average road density of 3.0 miles per square mile (WDNR 2004).

Forest ownership and management. Only about 4 percent of all lands in these WRIAs are in Federal ownership and only about one percent of all lands are being managed for long-term preservation by the national wildlife refuges and parks. Most of the Federal lands (three percent of all lands) are under management at the Whidbey Island Naval Air Station. None of the lands are under Tribal management. State lands represent about 10 percent of all lands in the region, and city/county lands represent less than 0.5 percent. The vast majority of lands in these WRIAs are in private ownership (85 percent). The San Juan and the Island WRIAs have almost the same percentage in private ownership (85 to 86 percent).

Approximately three percent of the forestlands in these WRIAs are in Federal ownership, none is in Tribal ownership, 12 percent are in State ownership, and 86 percent are in private or other ownership. Overall, lands covered by the forest practices rules represent approximately 92 percent of the forestlands in the region. Existing HCPs cover about 32 percent of the State-managed lands, but none of the private, county, and city ownerships. The percentage of forestlands that are subject to the forest practices rules ranges from 90 percent in the San Juan WRIA to 93 percent in Island County WRIA.

Small, 20-acre exempt forest landowners make up about one percent of the forestlands and about 1.1 percent of the forestlands subject to forest practices rules in these WRIAs, based on an analysis done only in the San Juan WRIA by Rogers (2003).

Estuarine and nearshore habitat. From a regional standpoint, the islands' major contribution to salmon productivity is its nearshore habitat. These WRIAs nearshore environment includes numerous estuaries and salt marshes and provides important habitat for spawning herring and other species that are food for salmonids. Much of the shoreline in Island and San Juan counties have been developed for single family homes and other development associated with recreational and leisure activities. Such development leads to tree removal and bank armoring, reducing shade and beach sand recruitment.

Twenty percent of the San Juan Island and Eastern Juan De Fuca Strait shoreline is considered modified (WSCC 2002c). Although these islands have no self-sustaining runs of anadromous salmonids (WSCC 2002c), nearshore habitats in these islands are important for various salmon runs from the Frasier (Canada), Nooksack, Skagit, Stilliguamish, and Snohomish Rivers.

Fish passage and barriers. Fish access is a major limiting factor in WRIA 6, though not yet identified as significant for anadromous fish. Culverts, tide gates, and dikes are the main structures impeding or preventing fish passage. A few small dams are also present. Low stream flow or poor temperature conditions (or both) can also hinder fish passage, especially during the summer (WSCC 2000a).

Water quality. Although high temperatures have been documented in a few streams in WRIA 2, there is no continuous monitoring or multi-year record of temperature problems. None of the streams in WRIAs 2 or 6 are considered to be impaired for temperature, turbidity or fine sediments (WDOE 2004). Several creeks are impaired by non-pollutants: for fish habitat in WRIAs 2 and 6, and for instream flow in WRIA 6.

2.1.3.4.2 North Puget Sound Watershed Resource Inventory Areas. WRIAs 1, 3, 4, 5, and 7 comprise most of the North Puget Sound watersheds. Major stream systems include the Nooksack, Samish, Skagit, Sauk, Stillaguamish and Snohomish River Basins, as well as other smaller tributaries. Portions of Whatcom, Skagit, Snohomish and King Counties are contained within these WRIAs. These WRIAs extends from the Puget Lowland physiographic province in the west to the Northern Cascades physiographic province in the east (Lasmanis 1991). The effects of past and present actions in this area are relevant to the biological requirements of several populations of listed and unlisted salmonids including Puget Sound Chinook, pink, chum, and coho salmon, Puget Sound steelhead, and each of the unlisted non-salmonids (possibly with the exception of sturgeon).

Since listing Puget Sound Chinook in 1999, NMFS completed approximately 22 formal interagency consultations in this analysis region. FHWA requested 11 consultations covering a variety of bridge repair or replacement, road construction and widening projects. The COE request six covering permitting actions for water system infrastructure, a marina dock, some engineered logjam projects, and the new Boeing Rail/Barge Facility in Snohomish County. FEMA completed three consultations for emergency repairs projects and BIA completed two for road stabilization and an engineered logjam project on the Lummi Reservation. Each of these consultations involved projects with temporary habitat effects from construction, and some with longer lasting effects on habitat from new infrastructure. For projects with the latter, none were found to jeopardize the listed species, and each included reasonable and prudent measures to minimize all anticipated take. For example, although the Boeing Rail-Barge Facility involved installation of new overwater structure affecting juvenile salmonid migration and food source productivity, the project also included measures to reduce the effects of overwater structure on food production, and to increase the extent of productive passable beach in the action area, over conditions existing before consultation.

Hydrology

These WRIAs includes several major river basins. The Nooksack, Skagit, Stillaguamish, and Snohomish rivers have their headwaters in the North Cascades and flow west through the Puget Lowland province to Puget Sound. Peak flows generally occur during the fall and winter months and commonly result from rain or rain-on-snow precipitation events. Spring snowmelt produces smaller magnitude peak flows while low flows occur during late summer and early fall. Based on the DNR stream hydrography GIS coverage, there are approximately 28,653 stream-miles (both fish-bearing and non-fish streams) in these WRIAs, with an average stream density of 4.17 stream miles per square mile.

Habitat

Land cover and use. Forestland makes up approximately 78 percent of these WRIAs. Agricultural lands in the lower elevations make up about seven percent of the region and ice, snow, and bare rock in the higher elevations make up about six percent. Approximately five percent of the region is mapped as shrub-land or grassland, and the remaining four percent consists of water and wetlands and residential/commercial lands. The percent forestland within each WRIA ranges from a low of about 67 percent in WRIA 3 (Lower Skagit/Samish) to a high of 89 percent in WRIA 5 (Stillaquamish) (NMFS and USFWS 2005). An analysis for road density in the region yielded an average road density of three miles per square mile (WDNR 2004).

Forest ownership and management. Approximately 53 percent of all lands in these WRIAs are in Federal ownership and the majority of these (representing 30 percent of all lands) are being managed for long-term preservation, primarily in national parks, national recreation areas, and wildernesses. State lands (primarily under management for timber production) represent 12 percent of all lands in the region, private lands represent 34 percent, and city/county lands represent one percent. The Federal Government manages the remainder.

Generally the upper basins are in Federal ownership, the middle basins are in State and private ownership, and the lower basins are in private ownership. For example, only two percent of the WRIA 3, which consists of the Lower Skagit and the Samish watersheds, is in Federal ownership, but 87 percent of WRIA 04, which consists of the Upper Skagit watershed, is in Federal ownership.

State timber management occurs on approximately 14 percent of the forestlands, and 31 percent of the forestlands are in private, county, or city ownership, where timber management occurs. Overall, lands covered by the forest practices rules represent approximately 45 percent of the forestlands in the region. Existing HCPs cover the vast majority (89 percent) of the State-managed lands, but less than one percent of the combined private, county, and city ownerships. WRIA 3 has the largest percentage of forest practices rules-covered lands (94 percent of all forestlands, 23 percent of which are covered by existing HCPs) and WRIA 4 has the lowest (14 percent of all forestlands, 26 percent of which are covered by existing HCPs).

Most of the private forestlands are located in the foothills west of the Cascade Range. Some private forestlands exist in the river valleys; however, much of this land has been converted to other uses. The lower foothills, especially in the southern and western parts of this region, are being converted to residential and other land uses.

Small, 20-acre eligible forest landowners make up about 0.7 percent of the forestlands and about 1.5 percent of the forestlands subject to forest practices rules in these WRIAs, based on the analysis by Rogers (2003). The small landowner parcels are mainly found in the lower elevation lands, especially along the major rivers. The highest percentage (about 2.5 percent of the forestland) is in the Lower Skagit/Samish (WRIA 3) and the lowest percentage (0.1 percent) is in the Upper Skagit (WRIA 4).

Approximately 11,283 stream miles occur on lands subject to forest practices rules in these WRIAs. This represents 39 percent of all streams in the region. Approximately 6,965 miles or 62 percent of the 11,283 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre eligible forest landowner parcels in this region is estimated to be about 0.9 percent and the percentage of all fish-bearing streams on small, 20-acre eligible forest landowner parcels is about 1.5 percent (Rogers 2003).

A dataset used by Lunetta et al. (1997) allowed isolation of data from the North Puget Sound WRIAs. Lunetta et. al. (1997) defined "response reaches" as the lower gradient (less than four percent) habitat where most of the anadromous fish production occurs. The data showed that 12 percent of the response reach riparian buffers (RRRBs) were classified as late seral stage. Thirty-five percent of the RRRBs were unforested, primarily as a result of urban and agricultural development. Another third of the data (35 percent) was classified as "other forestlands," which was defined to be "hardwood dominated, brush, or recent clearcuts."

In 2004, the DNR provided data on the percent of the riparian area in each watershed in the State occupied by small tree stages. Small tree stages were defined as having a quadratic mean diameter less than 10 inches. In other words, riparian areas with small tree stages represent early seral or successional forest stands that do not contribute to the ecosystem as much as older or later successional stands. The average percent of the riparian area in these WRIAs on DNR managed lands with small tree stages is 20 percent (WDNR 2004), indicating that under one quarter of the riparian area is presently not contributing to a properly functioning condition.

Sediment/mass wasting. Steep slopes and, in many foothill areas, relatively unconsolidated glacial deposits and phyllite bedrock formations, make this region vulnerable to landslides (WDNR 1993a, WDNR 1997a; WDNR 1997b). All watershed analyses in this region, except for the Woods Creek Watershed Analysis (WRIA 7) (WDNR 1993c), inventoried at least 100 landslides using historic aerial photos, and some inventoried more than 300. Sources also point to a significant shallow rapid landslide (SRL) problem. In the Nooksack Basin, over 2,200 landslides have been identified, with 37 percent associated with clearcuts and 32 percent associated with roads (WSCC 2002b). In the Stillaguamish Basin, 1,100 landslides have been inventoried since the 1940s (WSCC 1999). Lands prone to SRLS are often managed for timber, because they are unsuited to most other uses. Landslides can occur naturally, but inappropriate forest practices greatly accelerate their frequency.

These WRIAs are also characterized by several active glacial deep-seated landslides (DSLs) (WDNR 1993b; WDNR 1994), and a larger number of smaller dormant DSLSs. These are deep rotational bodies of unconsolidated and semi-consolidated glacial deposits. The Deer Creek landslide in the Stillaguamish River impacted fish habitat for 50 years (Eide 1990), and the Hazel landslide in the upper North Fork Stillaguamish is currently active and impacting habitat (WDNR 1998a). In this situation a stream or river typically undercuts the bases of these landslides, which destabilizes the landslide and causes it to gradually slip downhill. This, in turn, triggers bank collapses and SRLSs into the channel. Rerouting of channel flow into the toe of a DSLS may occur naturally, or as a result of human alterations (e.g., Hazel landslide, see WDNR 1998a). Besides the activated landslides, many dormant DSLSs could be activated by disturbing the toe, or by improperly routing water from road surfaces.

Fine sediment enters the channel from unpaved roads. Unpaved roads are widespread on industrial forestlands, and to a lesser extent, in rural residential areas and recreational forestlands. Industrial forestlands throughout Washington State have extensive networks of unpaved roads. Proper management of unpaved forest roads to reduce surface erosion, while similar in all regions of the State is somewhat easier in these WRIAs because of the availability of competent (hard) rock for road surface material.

Riparian/floodplain and wetland conditions. Historic or old growth timber harvest removed most of the riparian trees from the stream channels. This harvest started in the 1870s and was substantially completed by the 1960s. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zone along many agricultural areas are now dominated by alder, invasive canary grass and blackberries, and provide substantially reduced shade and LWD recruitment. It is difficult or impossible for native conifers to re-establish in buffers with these vegetative characteristics. The limiting factors reports (WSCC 1999; 2002a, 2002b, 2003) made frequent note of the deficiencies in riparian buffers on agricultural and urban lands. A photometric study by Lunetta et al. (1997) suggests that functional riparian buffers in urban and agricultural areas are substantially lacking.

For those riparian areas that remained in timber production, riparian stands harvested prior to 1972 were often allowed to regenerate naturally, although riparian harvest since 1972 has benefited from mandatory conifer regeneration requirements. Since the soils in many riparian areas are moist, hardwoods dominate many of them, at least initially.

Diking, agriculture, revetments, railroads and roads in lower stream reaches have caused significant loss of secondary channels in major valley floodplains in this region. Confined main channels create high-energy peak flow events that remove smaller substrates and LWD. The loss of side-channels, oxbow lakes, and backwater habitats result in a significant loss to juvenile salmonid rearing and refuge habitat. The lower South Fork Nooksack River has dikes along 60 percent of its length (WSCC 2002b). Sixty-two percent of the lower Skagit River and "much" of the Samish River is modified by diking and riprap (WSCC 2003). Diking and other floodplain impacts are not typically associated with commercial or small landowner forestry; however, some loss of floodplain functions has occurred in smaller mountain channels as a result of placing logging roads along stream channels.

The number and quality of freshwater wetlands has decreased. Wetlands provide rearing habitat, especially for coho, and play an important role in moderating streamflow extremes. Wetland loss is extensive in the lower Nooksack Basin, but this loss has not been quantified (WSCC 2002b). In the Stillaguamish Basin, wetland acreage declined from approximately 29,100 acres, historically, to 6,299 acres (WSCC 1999). In the Snohomish Basin, 74 percent of the floodplain wetlands have been lost (WSCC 2002a). The large scale loss of wetlands that has occurred in the major valley floodplains of these WRIAs is not typically associated with commercial or small landowner forestry; however, loss or alteration of smaller forested wetlands sometimes occurs by the placement of roads. Small forested wetlands are filled with road sediment under some circumstances.

Channel/hydrology conditions. Peak stream flows have increased over time due to paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain-on-snow events in higher elevation clearcuts. Groundwater withdrawal and increased peak flow can decrease surface flow during the dry season (WSCC 2003). Loss of forest canopies can substantially increase peak flow events due to "rain-on-snow" runoff. Warm heavy rain rapidly melts snow. Snow accumulations, especially at high elevations, are substantially greater on unforested surfaces than on forested surfaces. Clearcut areas at high elevations (above 1,200 feet) are particularly vulnerable to the effects of rain-on-snow, epecially in this region with the high mountains and heavy snow accumulations.

Estuarine and nearshore habitat. Estuaries are considered essential for the survival of juvenile salmonids that are in transition between freshwater and saltwater habitats. This habitat typically consists of salt marshes and mudflats. A number of recent studies have concluded that the loss of estuarine habitat in the Skagit River system is the single most important limiting factor for salmonid production in that system (WSCC 2003). The Stillaguamish River lost 85 percent of its tidal marshland between 1860 and 1968, mostly before 1886 (WSCC 1999). The Skagit Basin has lost 72 percent of its inter-tidal habitat (WSCC 2003), and the Snohomish Basin has lost 32 percent of its habitat (WSCC 2002a). Intertidal habitat has been lost in the Nooksack basin although this loss is not quantified (WSCC 2002b).

The nearshore marine habitat is the saltwater shoreline. The substrate is typically mud, sand or gravel along the eastern side of Puget Sound. Vegetation may include eelgrass, kelp, and other marine macrophytes. This habitat has been extensively altered near the Skagit River (WSCC 2003). Estuarine and nearshore habitat losses are not typically associated with forestry (WSCC 1999; WSCC 2002a; WSCC 2003).

Large woody debris. Historic riparian harvest has affected past and present recruitment of LWD. The retention of in-channel LWD has been impacted by removal of LWD for navigational purposes, dikes and levee interference, debris torrents, and under previous generations of the State's forest practices rules. Additionally, existing in-water LWD is affected by anthropogenic channel confinement (such as the construction of dikes for flood control in valley bottoms) as confined channels create flow conditions that move LWD downstream during peak flows.

The increased frequency of landslides and debris torrents, as a result of timber harvest, has increased LWD recruitment in steep hillslope channels. However, landslide-recruited LWD is less likely to contribute to fish habitat because landslides deposit large amounts of sediment along with the wood they transport, diminishing overall habitat recruitment value of the wood. Futhermore, such recruitment is often transported in debris torrents and deposited in large logjams in relatively short sections at the foot of the hill (McGarry 1994), or the wood gets flushed out into the main valley channels and delivered far downstream.

Most of the watershed analyses conducted in the region have noted a difference in LWD recruitment potential between managed forestlands and non-forestland uses (i.e., residential, urban and agricultural; WDNR 1993a, WDNR 1994, WDNR 1997a, WDNR 1998a; also see Lunetta et al., 1997). In all cases, the potential future LWD recruitment was substantially better in managed forestlands. This is a result of either narrow or absent riparian tree buffers on residential, urban, and agricultural land.

Because of historic timber harvest and the long period of time it takes for riparian forests to regenerate and recruit LWD to the channel, most managed forestland stream channels (with gradients less than six percent) have reduced levels of LWD. These riparian forests have generally regenerated as alder, a tree that typically lives only 80 years, and rots quickly when recruited to the stream channel (Harmon et al., 1986). Thus, alder LWD is less functional than other hardwoods and conifer species; although recent research suggests that alder leaf-litter may be an important source of nitrogen for the aquatic food chain (e.g., Wipfli and Gregovich 2002). Marshall and Associates (2000) conducted a detailed photometric study of riparian buffers and found that 50 percent of the private forestland buffers in these WRIAs were hardwood-dominated. The remaining buffers were composed of both mixed hardwood and conifer, or conifer-dominated. Mixed riparian buffers are considered to be on a successional pathway to conifer domination.

In steeper stream channels of this region, LWD retention is the primary issue, rather than LWD recruitment. Debris torrents have removed most of the LWD in the channels where they have recently occurred. Debris-torrent-scoured channels have greatly diminished habitat value, and typically take years or decades to recover. LWD has a particularly important role in controlling channel incision in channels crossing unconsolidated glacial deposits. These channels may not have sufficient natural armoring (i.e., boulders large enough to resist mobilization at peak flows) to prevent incision without large LWD (see WDNR 1998b).

Fish passage and barriers. The upper Skagit River, above the Gorge Dam, was naturally inaccessible to anadromous fish, with the possible exception of steelhead. The Baker River dams have upstream and downstream fish passage structures. In recent years, these structures have functioned well enough to contribute to the recovery of Baker River sockeye salmon (WDFW 2003).

Water quality. Extensive loss of vegetative cover may contribute to increased groundwater temperatures, which may impact thermal refuges in the larger channels. Channelization, water withdrawals, loss of wetlands, and altered land cover have resulted in inadequate stream flows in some drainages.

Most of the watershed analyses conducted in the region made note of the disparity between shade in managed forestlands, and non-forest land uses (i.e., residential, urban and agricultural), with conditions being substantially better in managed forestlands (WDNR 1998a; WDNR 1994; WDNR 1993). Similarly, limiting factors analysis reports note poor water quality (high temperature, fine sediment) in the floodplain channels where agriculture and urban/residential development have prevailed (WSCC 1999). Riparian condition in managed forestlands was mixed, with some areas still impacted by historic harvest of riparian areas. Riparian zones associated with agriculture and rural residential land uses are the most severely degraded (WSCC 1999). Past riparian timber harvest has removed shade and impacted water temperature; however, recovery can be rapid in small stream channels, because smaller trees can provide adequate shade. Temperature impacts from riparian harvest along wider channels (i.e., greater than 30 feet) are less significant, because, even under natural conditions, the channel is only partially shaded by riparian trees and water temperatures are naturally higher. However, tall trees do affect water temperature on larger channels, thus temperature recovery from riparian timber harvest takes longer.

Fifty two percent of the riparian buffers on private timberlands regenerated from historic timber harvest as hardwood-dominated stands (i.e., greater than 70 percent hardwoods; Marshall and Assoc. 2000), with most of this being alder. Because alder has a short life span (80 years) and limited height potential (50 to 90 feet depending on soil and climate), they are less effective in shading wider channels. Severe debris torrents can remove enough riparian trees to impact shade and water temperature. This was noted in at least two watershed analyses (WDNR 1997; WDNR 1997b; see also Beschta and Taylor 1988; Coho and Burges 1994).

In WRIA 1, Whatcom Creek has high temperatures and portions of the Nooksack River are impaired due to high temperatures, low instream flow and excessive fine sediment. A few tributaries of the Lower Skagit River in WRIA 3 are impaired due to high temperatures. In WRIA 5, portions of the Stillaguamish River are impaired due to high temperatures (as are a few of its tributaries) and low dissolved oxygen. The Snohomish, Snoqualmie and Pilchuck rivers in WRIA 7 are also impaired by high temperature.

Elevated levels of nutrients have been documented in the lower main-stem Skagit River, presumably from urban and highway runoff, wastewater treatment, failing septic systems, agriculture or livestock impacts. Loss of riparian habitat, sedimentation, hydrologic alterations (wetland losses), inputs from agriculture, and failing septic systems have resulted in water quality problems such as warm water temperatures, increased nitrogen and phosphorus, and higher levels of turbidity.

Chemical use in forestlands is substantially limited to herbicide applications to suppress alder, maple, and brush competition during early phases of conifer forest regeneration. No local factors exist to suggest that impacts from herbicides would be different from other regions in Washington State.

Hydropower

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected Chinook salmon populations in several river systems. The construction and operation of dams have blocked access to spawning and rearing habitat, changed flow patterns, resulted in elevated temperatures and stranding of juvenile migrants and degraded downstream spawning and rearing habitat by reducing recruitment of spawning gravel and LWD to downstream areas. In Puget Sound, approximately 150 mainstem river miles of habitat (not including tributaries within those areas) are inaccessible to anadromous salmonids due to hydropower dam development (S. Fransen, NMFS Hydro Division, pers. comm.). This total excludes areas above impassable dams that have been made accessible to salmon and O. mykiss through active fish trap and haul operations. Migrating fish are also diverted into unscreened or inadequately screened water conveyances or turbines, resulting in unnecessary mortality. Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in the Skagit and, Skokomish river basins.

Two dams on the upper Skagit River and two dams on the Baker River are major hydropower storage facilities that modify the seasonal and daily discharge in the Skagit River, and have a substantial impact on the Skagit System (WSCC 2003). Hydro-modification in the Skagit River system has resulted in a loss of 64 percent of its distributary sloughs and 45 percent of side channel sloughs (Bishop and Morgan 1996). A municipal water facility and a small hydropower project reduce total discharge on the Tolt River, a tributary to the Snoqualmie River. In addition, at least four run-of-the-river hydropower projects exist in the region; one on the Nooksack River and three on the Snoqualmie River.

Except for run-of–the-river projects, these river facilities have been trapping substrate for decades, and the downstream reaches are gravel deficient. Most of the dam sites also intercept LWD and do not pass it downstream. These two actions have caused the downstream channel to incise and/or become simplified, thus impacting fish habitat. Water withdrawal has reduced available fish habitat and altered sediment transport. Hydropower projects have also caused the fluctuation of flow, which strands and often kills fish and reduces aquatic invertebrate productivity (Hunter 1992). Skagit and Baker River hydropower projects continue to fluctuate flow daily (hydro-peaking), although this has been somewhat modified in recent decades.

Hatcheries

Anadromous salmonid hatchery programs are widespread within the Puget Sound Chinook salmon ESU. There are 41 individual hatchery programs that produce Chinook salmon in the region, and 74 more that release other species, including coho, chum, and pink salmon, and steelhead. Many of the Chinook hatchery programs in the Puget Sound region have been in operation for at least five decades. Chinook salmon hatchery programs are operated for harvest augmentation and stock recovery purposes. Nearly all of the state-funded harvest augmentation programs produce fall-run Chinook salmon. The 1990-1997 average annual fall Chinook salmon production from all Puget Sound hatcheries was 3.1 million yearlings, 46.3 million sub-yearling smolts, and 12.3 million fry-fingerlings (fish less than a size of 150 mm fork-length) (WDFW data). Supplementation of depleted native Puget Sound spring and summer run Chinook populations has been the subject of most stock recovery programs in the region. The 1990-1997 average annual spring and summer Chinook salmon production from all Puget Sound region hatcheries was 1.4 million yearlings, 1.6 million sub-yearling smolts, and 0.96 million fry-fingerlings.

The co-managers' Chinook hatchery RMP (WDFW and PSTT 2004) includes hatchery reform measures applied to decrease risks to listed Chinook salmon posed by the 41 artificial propagation programs operating in the ESU. For example, the total annual production of yearling fall Chinook salmon from WDFW-managed programs with harvest augmentation objectives is proposed to be reduced from 3.8 million fish (2000 release level) to under two million fish. When implemented, this reduction is expected to reduce predation risks for emigrating natural-origin juvenile Chinook salmon in Puget Sound region freshwater and estuarine areas. Domestication risks posed by interbreeding between yearling-origin adult hatchery fall Chinook and natural-origin Chinook may also be reduced with this yearling fish release reduction. Under the RMP, inter-basin transfers of fall Chinook salmon will continue to be curtailed, requiring transition to the use of only indigenous or localized broodstock for harvest augmentation programs. This measure is designed to decrease among population diversity reduction risks to remaining natural Chinook populations, and the risk of hatchery fish straying to natural Chinook production streams. For "category 2" watersheds, use of local broodstocks only will help preserve extant native populations until further genetic and demographic data is collected and evaluated to allow for determination of appropriate stock management actions.

Summary of Factors Affecting Covered Species in these WRIAs

Primary factors limiting the survival and recovery of the Skagit River Basin Chinook populations are: insufficient juvenile rearing conditions and capacity in the Skagit Bay estuary, the Skagit River delta and flood-plain, and the lower Skagit River; insufficient adult spawning capacity; excessive mortality during incubation; and, insufficient juvenile rearing conditions and capacity in mainstem and tributary habitats. Degradation and loss of the Skagit River estuary for the rearing of ocean-migrating Chinook fry is a predominant limiting factor of the Skagit River Chinook populations. Degraded conditions of floodplain and channel structure in the lower Skagit River, through which all six populations travel to and from the ocean, result in simplified and lost juvenile rearing areas (i.e., off-channel areas, mainstem areas, and Skagit River tributaries) (Bishop and Morgan 1996). Tributary habitats important for Chinook spawning and rearing have been degraded through the loss of pool habitat area due to increased sediment, removal of LWD and lack of recruitment of LWD.

Primary factors limiting the survival and recovery of the Stillaguamish Basin Chinook populations are: excessive mortality during incubation; insufficient juvenile rearing conditions and capacity in mainstem and tributary habitats; inadequate migration, holding, and spawning conditions in the mainstem rivers and their tributaries; and insufficient rearing conditions and capacity in the estuary. Degraded floodplain and channel structure, dysfunctional sediment-routing, and loss of mature riparian forests have destabilized, simplified, and destroyed the habitats required for migration, spawning and rearing (i.e., off-channel areas, mainstem river areas, and tributaries). Degraded conditions and loss of lower river and estuarine areas for the rearing of ocean-migrating Chinook is also a main limiting factor to recovery of the Stillaguamish River Chinook populations.

Primary factors limiting the survival and recovery of the Snohomish Basin Chinook populations are insufficient rearing conditions and capacity in the estuary, insufficient juvenile rearing conditions and capacity in mainstem and tributary habitats, excessive mortality during incubation, and inadequate spawning conditions and capacity in the mainstem rivers and their tributaries. Dysfunctional rearing habitats in the lower river and estuarine areas is a primary limiting factor to recovery of the Snohomish River Chinook populations, i.e., degraded conditions and loss of important habitats for the rearing of ocean-type Chinook. In addition, degraded floodplain and channel structure processes, dysfunctional sediment-routing, and loss of mature riparian forests have resulted in destabilized, simplified and destroyed tributary, off-channel, mainstem river, estuarine and nearshore areas required for migration, spawning and rearing.

The current major limiting factors and threats to the recovery of Chinook populations in this region are insufficient juvenile rearing capacity and conditions resulting from estuarine habitat loss and degradation, and degraded floodplain and channel structure processes. The other primary limiting factors are dysfunctional sediment-routing; loss of mature riparian forest; and degraded water quality. Along with degraded floodplain and channel structure, these latter factors adversely affect adult spawning, egg/fry incubation, and juvenile rearing capacity and conditions in the tributary, mainstem river, estuarine, and nearshore areas used by the Chinook populations in this region.

2.1.3.4.3 <u>South Puget Sound Watershed Resources Inventory Areas</u>. WRIAs 8, 9, 10, 11, 12, and 13 include Lake Washington, Cedar River, Sammamish River, Green River, Duwamish River, Soos Creek, Puyallup River, White River, Carbon River, Nisqually River, Deschutes River and South Sound independent tributaries. Portions of Snohomish, King, Pierce, Thurston, and Lewis Counties are contained within these WRIAs. The effects of past and present actions are relevant to the biological requirements of several populations of Puget Sound Chinook, several unlisted salmonids, and several of the unlisted non-salmonid species in these WRIAs, as described below.

Since 1999, NMFS completed 47 formal interagency consultations in these WRIAs. The majority of these (22) were with the COE covering permitting actions including residential docks, piers, and bank stabilization (bulkhead) projects in Puget Sound, Lake Washington, Lake Union, and Lake Sammamish. EPA requested 10 consultations covering remedial actions such as contaminated sediment removal in the Lower Duwamish River and in Commencement Bay, as well as infrastructure projects for bank stabilization and fish passage improvements. FHWA requested formal consultation eight times covering federally funded transportation infrastructure projects such as road widening and bridge replacement. NMFS consulted on four of its own proposed actions including twice for the issuance of Incidental Take Permits to the Cities of Seattle and Tacoma for their respective watershed operations programs. None of these consultations concluded with a jeopardy determination and each included reasonable and prudent measures to minimize the anticipated effects of take from each action.

Habitat

Land cover and use. Forestland makes up approximately 70 percent of these WRIAs. Residential and commercial lands represent the next largest cover type, making up approximately 17 percent of the region. Agricultural lands make up about five percent, water and wetlands make up about three percent, and other types comprise the remaining five percent. The extent of forest within each WRIA ranges from a low of about 35 percent in the Chambers-Clover (WRIA 12) to a high of 86 percent in the Nisqually (WRIA 11) (USFWS 2005).

This region is one of the most developed and populated regions of the State, and managed forestlands are fragmented and sparse in the floodplains and lower foothills. Urban development has significantly impacted nearshore areas, estuaries, freshwater wetlands and floodplains. An analysis for road density in the region yielded an average road density of 4.9 miles per square mile (WDNR 2004). Some of the remaining managed forestlands in the Cascade Range and higher foothills are vulnerable to landslides.

Forest ownership and management. Approximately 22 percent of all lands in these WRIAs are in Federal ownership and a portion of these lands (about nine percent of all lands) are being managed for long-term preservation, primarily in national parks, wildernesses, and national recreation areas. Tribal lands represent about one percent of the region. State lands represent eight percent of all lands in the region, private lands represent 64 percent, and city/county lands represent slightly less than one percent. The remainder is managed by the Federal government.

The vast majority of the Federal lands managed for long-term preservation and other National Forest System lands are in the upper parts of the Puyallup-White and Nisqually (WRIAs 10 and 11, respectively). Private lands make up the largest percentage of the Deschutes (WRIA 13) at 90 percent and the lowest percentage of the Puyallup-White and Nisqually (WRIAs 10 and 11, at 53 and 54 percent, respectively.)

Approximately 26 percent of the forestlands in these WRIAs are in Federal ownership, 10 percent are in State ownership, less than one percent are in Tribal ownership, and 63 percent are in private or other ownership. Overall, lands covered by the forest practices rules represent approximately 73 percent of the forestlands in the region. Existing HCPs cover the majority (69 percent) of the State-managed lands, and 16 percent of the combined private, county, and city ownerships. WRIA 8 (Cedar-Sammamish) has the largest percentage of forest practices rules-covered lands (98 percent of all forestlands, 46 percent of which are covered by existing HCPs) and WRIA 10 (Puyallup-White) has the lowest (55 percent of all forestlands, only one percent of which are covered by existing HCPs).

Most of the private forestlands are located in the lowlands, outside of and on the edge of developed areas. Because of this and because of the rapid population growth that is occurring in this region, many of these lands have been or will be converted to other uses. Small, 20-acre exempt forest landowners make up about 0.6 percent of the forestlands and about 0.8 percent of the forestlands subject to forest practices rules in these WRIAs, based on the analysis by Rogers (2003). The small landowner parcels are mainly found in the lower elevation lands, especially along the major rivers. The largest concentrations, ranging from 1.0 to 1.6 percent of the forestland, respectively, are in the Nisqually (WRIA 11) and the Chambers-Clover WRIAs (WRIA12); all remaining WRIAs have percentages ranging from 0.6 to 0.8 percent of forestland.

Approximately 8,535 stream miles occur on lands subject to forest practices rules in these WRIAs. This represents 62 percent of all streams in the region. Approximately 4,870 miles (57 percent) of the 8,535 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be less than one percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 1.2 percent (Rogers 2003).

A data set used by Lunetta et al., (1997) allowed isolation of data for the South Puget Sound WRIAs. The data showed that almost four percent of the RRRBs are classified as late seral stage. Thirty percent of the RRRBs were unforested, primarily as a result of urban and agricultural development. Twenty-seven percent of the RRRBs are mid- or late-seral conifer-dominated stands. In other words, these are riparian stands that are either currently fully functional or on a pathway to functional recovery. Thirty-eight percent of RRRBs are classified as “other forestlands,” defined to be “hardwood dominated, brush, or recent clearcuts.”

Sediment/mass wasting. Steep slopes created by geologically recent alpine glaciation, moderately weathered rock and heavy precipitation make the Cascade Range within the region moderately vulnerable to landslides and debris torrents. All watershed analyses records in the Cascade Range of this region (WDNR 1996a; 1996b; 1998d; 2002) exceeded 90 inventoried landslides per Watershed Administrative Unit (WAU). Forest practices and historic fires have contributed or triggered most of these landslides. Outside the Cascade Range, landslides are less frequent, but may occur along high terraces and outside bends of rivers.

Weathered Oligocene volcano-clastic rocks contribute to the sensitivity in upper Green River Basin and Nisqually Basin (WDNR 1998c; WDNR 1998d; WDNR 2002). In the upper White River Basin (WRIA 10), 625 landslides were inventoried in two watershed analysis units (WAUs) (WDNR 1996a). The geology here is a mix of intrusive and volcanic rock. In the Mashel Watershed Analysis in WRIA 11 (WDNR 1996b), 362 landslides were inventoried, these being mostly debris torrents and SRLSs. The Mashel WAU is composed of weathered sedimentary rocks and more recent intrusive, volcanic, glacial and alluvial material. Forest practices and historical fires have contributed or triggered most of these landslides (WDNR 1996a; WDNR 1996b; WDNR 1998c; WDNR 1998d; WDNR 2002).

Numerous earth flows and deep-seated landslides of various sizes are reported in the upper Green River Basin (WDNR 1998c; WDNR 2002) and upper Nisqually basin (WDNR 1998d). In both cases, the geology was described as weathered Oligocene volcano-clastic rocks. Earth flows are DSLSs composed of fine sediment and are partially rotational and partially elastic.

Like other DSLSs, the toe of the slide is undercut by a stream, causing the formation to slip slowly down. This can cause the banks to collapse, and trigger SRLSs. In addition to the upper Green River earth flows, several river-adjacent DSLSs exist in the middle Green River. These are a major source of sand for the mid- and lower Green River. A series of earthflows were identified along the lower Mashel River as well.

Fine sediment also enters the channel from unpaved roads. Unpaved roads are widespread on industrial forestlands, and, to a lesser extent, in rural residential areas and recreational forestlands. Commercial forestlands throughout Washington State have extensive networks of unpaved roads, and these WRIAs are no exception.

Riparian/floodplain and wetland conditions. Past old growth timber harvest removed most of the riparian trees from the stream channels. In this region, this practice started in the 1860s and was substantially completed by the 1950s. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zone along many agricultural areas are now dominated by alder, invasive canary grass and blackberry, and provide substantially reduced shade and LWD recruitment. It is difficult or impossible for native conifer to re-establish in buffers with these vegetative characteristics. Widespread urbanization has permanently impacted riparian buffers throughout the lowlands in this region. The limiting factors reports for this area (WSCC 1999a; 1999b; 1999c; 2000; 2001) made frequent note of the deficiencies in riparian buffers on agricultural and urban lands. A photometric study by Lunetta et al. (1997) suggests that functional riparian buffers in urban and agricultural areas are substantially lacking.

Most riparian stands harvested prior to 1972 but remaining in timber production, regenerated naturally. Hardwoods dominate many of the riparian areas since the soils are generally moist. Since 1972, on state and private lands, riparian buffers have benefited from mandatory conifer regeneration requirements, although it is not clear that the establishment of conifer was consistently successful.

Diking, widespread floodplain development, and channel revetments have caused significant loss of secondary channels and wetlands in the lower Green, lower Cedar and lower Puyallup floodplains (WSCC 1999b; 2000; 2001). Confined channels create high-energy peak flow events, resulting in coarser substrates and a reduction in LWD. The loss of side-channels, oxbow lakes and wetlands represents a significant loss of juvenile salmonid rearing and refuge habitat (WSCC 2000). When the water level of Lake Washington was dropped nine feet in the 1910s, thousands of acres of wetlands along the shoreline of Lake Washington, Lake Sammamish and the Sammamish River corridor were drained and converted to agricultural and urban uses (WSCC 2001).

Although wetland and floodplain habitat losses are extensive in this region, little of this land is currently managed for forestry. Small stream-adjacent wetlands in forested drainages can be impacted by inappropriate placement of roads and filled by road sediment. The scale of this loss is small compared to the loss from urban and agricultural lands in this region.

Channel/hydrology conditions. Peak stream flows have systematically increased over time due to land use activities including paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain-on-snow events. Increased peak flow may decrease surface flow during the dry season due to reduced ground water recruitment (WSCC 1999a; 2000; 2001). Loss of forest canopies can substantially increase peak flow events because of what is referred to as ‘rain-on-snow’ runoffs, which occur when heavy warm rain falls on a snowpack. Snow accumulations, especially at high elevations, are substantially greater on unforested surfaces than on forested surfaces. Rain-on-snow events are primarily a concern with clearcut timber harvests at high elevations (above 366 meters). Within this region, it is a concern in the Cascade Range along the eastern margin.

Estuarine and nearshore habitat. Estuary habitat is considered essential for the survival of juvenile salmon that are in transition between freshwater and saltwater habitats, particularly chum and Chinook salmon. Because drainage from Lake Washington has been rerouted from the Duwamish River to the shipping canal, this basin has no estuary, and this may impact early marine survival of populations from this basin (WSCC 2001). The Duwamish and Puyallup basin estuaries are the major shipping ports for Washington State and are also extensively industrialized (WSCC 1999b; 2000). Both estuaries have been severely impacted. One hundred percent of estuarine wetlands have been filled in the lower Duwamish Basin, and the main channel has been dredged for shipping and diked for flood control. In the Puyallup estuary, eleven percent (187 acres) of the intertidal mudflats remain, whereas one percent (57 acres) of the emergent wetlands exist (COE et al., 1993). The Nisqually Basin estuary is essentially preserved in Federal and State wildlife refuges, and is the least modified estuary in Puget Sound (WSCC 1999b). The estuary for the Deschutes Basin is modified by the creation of a freshwater lake (Capitol Lake) and moderate urban and residential development (WSCC 1999a).

The nearshore marine habitat has been extensively altered and armored by industry activities and intensive residential development near the mouths of the Cedar-Sammamish Basin, Duwamish Basin, and the Puyallup Basin. A railroad runs along most of the shoreline adjacent to these three basins, which eliminates natural cover along the shore and natural recruitment of beach sand. When erosion occurs, the railroad bed is aggressively armored with large riprap (WSCC 2001). Piers and buildings are common in some areas, and dredging has occurred to allow shipping and boating access adjacent to the shoreline (WSCC 1999a; 2000; 2001). The nearshore environment close to the Nisqually River mouth is lightly impacted by some residential development (WSCC 1999c). The mouth of the Deschutes River is moderately impacted by residential development, marinas and an international trade port (WSCC 1999a). Estuarine and nearshore habitat losses are not typically associated with commercial or small landowner forestry.

Large woody debris. The recruitment of LWD has been impacted by past harvest of riparian forests and the failure to re-establish these riparian forests on lands converted to other uses. The retention of in-channel LWD has been impacted by removal of LWD for navigational purposes, dikes and levy interference, debris torrents and historic removal of wood as a misguided fisheries management tool. The confinement of valley floor river channels by diking assures rapid downstream transportation of LWD during peak flows.

Landslides typically increase LWD recruitment into steep hillslope channels. However, landslide-recruited LWD is less likely to contribute to fish habitat. Such recruitment is often transported by debris torrents and deposited in piles in relatively short sections where channel gradient and confinement decline enough to allow deposition (McGarry 1994). In other instances, LWD gets flushed out into the main valley channels and delivered far downstream. Debris-torrent-scoured channels have greatly diminished habitat value, and will take years or decades to recover.

Because of the long duration of time it takes for riparian forests to regenerate and provide recruitment of LWD to the channel, most low-gradient (less than six percent) stream channels have reduced levels of LWD. Larger streams need larger trees to achieve effective LWD function; thus, at least some trees in the 50 to 100 centimeter (cm) diameter at breast height (dbh) range are needed (Bilby and Ward 1989; Grette 1985). The riparian forests along many low-gradient streams regenerated as alder is less functional than other hardwoods and coniferous species. Marshall and Assoc. (2000) conducted a detailed photometric study of riparian buffers and found that 51 percent of the private forestland buffers in these WRIAs were hardwood-dominated (greater than 70 percent hardwood by composition), with most of this being alder. The rest of forestland buffers were either mixed-hardwood-conifer, or conifer-dominated. Mixed buffers typically become conifer-dominated if left undisturbed.

Fish passage and barriers. Dams constructed for hydropower generation, irrigation or flood control have substantially affected Chinook salmon populations in several river systems. The construction and operation of dams have blocked access to spawning and rearing habitat, changed flow patterns, resulted in elevated temperatures and stranding of juvenile migrants and degraded downstream spawning and rearing habitat by reducing recruitment of spawning gravel to downstream areas.

Passage to the upper Lake Washington watershed had been eliminated at the turn of the century with the construction of the Landsburg Dam. In 2003, passage was restored as part of Seattle's Cedar River Watershed Managment Habitat Conservation Plan. This action opened 17 miles of good quality habitat to Chinook, coho, and steelhead returning to the Cedar River watershed. In the Puyallup River watershed, Mud Mountain Dam limits upstream adult migration. Habitat suitability below the dam is constrained by the flow regime. Natural-origin adult fish are trapped at a diversion dam below Mud Mountain Dam and transported into the upper watershed, above Mud Mountain Dam. Adult passage in the Puyallup River system was restored at Electron Dam by the construction of a fish ladder in 2001.

In the Nisqually River watershed, native spring and fall Chinook populations have been extirpated primarily as a result of blocked passage at the Centralia diversion, and dewatering of mainstem spawning areas by hydroelectric operations.

Water quality. Groundwater withdrawal and increased peak flow may decrease surface flow during the dry season. Loss of riparian trees will increase water temperature where the open channel is less than 100 feet wide (Sullivan et al., 1990). Extensive loss of vegetative cover can increase groundwater temperatures, which may impact surface water temperatures. Channelization, water withdrawals, loss of wetlands, and altered land cover have resulted in inadequate stream flows in some drainages. Past riparian timber harvest has removed shade and increased water temperatures; however recovery is quicker in small stream channels, because smaller trees provide a greater proportion of required shade sooner on small channels. Poor water quality (high temperature, fine sediment) was relatively frequent in association with floodplain channels where agriculture and urban/residential development predominate (WSCC 1999b; 2000).

Riparian conditions in managed forestlands were mixed. Temperature impacts from riparian harvest along wider channels (i.e., greater than 10 meters [approximately 33 feet]) are less significant because, even under natural conditions, the channel is only partially shaded by riparian trees and water temperatures are naturally higher. This problem is compounded by the fact that 51 percent of the riparian buffers in these WRIAs regenerated from timber harvest as hardwood-dominated stands (i.e., greater than 70 percent hardwoods). Severe debris torrents can remove enough riparian trees to impact shade and water temperature (Beschta and Taylor 1988, Coho and Burges 1994).

Waters impaired by temperature in this region include portions of the Sammamish River in WRIA 8, the Green River in WRIA 9, the Clearwater River, Lower White River, Boise Creek and Wilkeson Creek in WRIA 10, and the Deschutes River in WRIA 13 (WDOE 1998, 2004). Temperature TMDLs have been done for the Upper White River basin (Ketcheson et al., 2003) and South Prairie Creek/Wilkeson Creek (Barreca and Roberts 2003).

Dissolved oxygen impairments include portions of the Sammamish River and certain tributaries of the Green River. A TMDL on dissolved oxygen has been done for the Puyallup River (Pelletier 1993). The Upper Deschutes River is impaired due to excessive fine sediment.

Chemical use in forestlands is substantially limited to herbicide applications to suppress alder, maple, and brush competition during early phases of conifer forest regeneration. No regional factors exist to suggest that impacts from herbicides would be different in this region than other regions in Washington State.

Hydropower

The Cascade headwaters of the Cedar and Green Rivers are both managed as municipal water supplies and are dammed to provide storage to meet summer water demands for urban areas. The Mud Mountain Dam on the White River is a COE flood control structure. Puget Sound Energy maintained and operated diversion and hydropower generating infrastructure on the White River, diverting White River flow to Lake Tapps. The lake supports recreational and residential development, and discharge from Lake Tapps was used to generate power until recently. Presently, the Cascade Water Alliance is working to secure water rights related to that diversion on behalf several municipalities for their water supply. The Electron Dam is a run-of-the-river project that reduces flow in the upper Puyallup River for approximately 8 miles. The upper Nisqually River has two large dams, the Alder and LaGrande. The Alder Dam is the largest in this region. In addition, the Yelm Hydropower Project on the lower Nisqually River reduces flow in a 10-mile stretch of the river.

Except for the two run-of-the-river projects, these dams have been trapping substrate for decades, and the downstream reaches lack sufficient gravel. Most of the dam sites also intercept LWD and do not pass it downstream. These two actions tend to promote downstream channel incision and/or simplification, limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often fluctuate flow, stranding and killing fish, and reducing aquatic invertebrate (food source) productivity (Hunter 1992).

Summary of Factors Affecting Covered Species in these WRIAs

These WRIAs present both forestry and non-forestry related habitat limitations. Those limitations include dams, passage barriers and hydroelectric power generation, roads and railroad placement, urbanization, point and non-point pollution input, modified stream channels, stormwater run-off, industrial development and pollution input, mine tailing input, shoreline bank armoring, over-water structures, lack of LWD, water withdrawals, water diversions, flood control, dredging and filling, non-native species competition, predation, agricultural practices and pollutant inputs, revetments, timber harvest, levees and impoundments, recreational boating, road building, military activities, and invasive vegetation spread (SSHIAP 2004). These conditions in the tributary, mainstem river, estuarine, and nearshore areas used by the Chinook populations in this region adversely affect adult spawning, egg/fry incubation, and juvenile rearing capacity.

All of those elements have contributed directly and indirectly to a combination of major limiting factors in this area of the State. Those limiting factors are fish access and migration barriers, altered hydrology and flows, increased sedimentation and altered sediment transport, sediment contamination, loss of channel complexity, connectivity and off-channel habitat, degradation of the riparian conditions, poor water quality and quantity, impeded biological processes, non-native species spread, reduction and degradation of riparian, estuarine and wetland habitat functions, excessive sedimentation, decreased water quality, scour and gravel starvation, low flows, dewatering, loss of LWD, bed-load movement, mass-wasting/debris flows, increased peak flows, and temperature (SSHIAP 2004). All of these limiting factors combine to impair the baseline condition in this area.

2.1.3.4.4 West Puget Sound and Hood Canal Watershed Resources Inventory Areas. WRIAs 14, 15, 16, 17, and 18 include the Skokomish, Duckabush, Dosewalips, Big Quilcene, Elwha, and Dungeness Rivers, as well as other South Sound and Hood Canal tributaries. Portions of Thurston, Mason, Kitsap, Jefferson, and Clallam Counties are included within these WRIAs. The West Puget Sound region extends from the Puget Lowland physiographic province in the east to the Olympic Mountains physiographic province in the west (Lasmanis 1991). Elevations range from sea level to almost 8,000 feet. The effects of past and present actions in this area are relevant to the listed and unlisted salmonids including Puget Sound Chinook, Hood Canal summer chum, and several of the unlisted non-salmonid species.

Since 1999, NMFS completed 11 formal ESA consultations in this area of the State. Seven of these were with the COE and covered two residential docks or piers, two bulkhead replacements, one bank stabilization, one dredging, and the Goldsborough Creek Restoration project. NMFS also consulted with the Department of the Navy twice for Drydock Operations and submarine base Bangor and for Nimitz Homeport Berth Improvements. None of these consultations concluded with a jeopardy determination, and each included reasonable and prudent measures to minimize the effects of anticipated take of listed species. The Nimitz berth improvements project included measures to improve juvenile migration in the area of the Bremerton Naval ShipYard and other mitigation projects that were developed in coordination with the Suquamish Tribe. In addition to these consultations, NMFS completed consultation with the Federal Energy Regulatory Commission (FERC) on dam operations at Cushman Dam on the North Fork Skokomish River in 2004.

Hydrology

These WRIAs contain several rivers, all of which originate in the Olympic Mountains. The Elwha and Dungeness rivers drain north into the Strait of Juan de Fuca while the Dosewallips, Duckabush, Hamma Hamma, and Skokomish rivers drain east to Puget Sound. The hydrologic regime of these systems is similar to other western Washington rivers. Peak flows generally occur during fall and winter and as a result of rain or rain-on-snow precipitation events while low flows occur during late summer or early fall. Smaller magnitude peak flows sometimes result from spring snowmelt. Based on the DNR stream hydrography GIS coverage, there are approximately 9,114 stream-miles (both fish-bearing and non-fish bearing streams) in these WRIAs, with an average stream density of 3.36 stream miles per square mile.

Habitat

Land cover and use. Forestland makes up approximately 88 percent of these WRIAs. Ice, snow, and bare rock represent about two percent, residential and commercial areas make up four percent, and agricultural lands make up about three percent of the region. Individual WRIAs consist of between 84 and 92 percent forestland. Residential and commercial lands make up the highest percentage (12 percent) of WRIA 15 (Kitsap) and the lowest percentage (0.2 percent) of WRIA 16 (Skokomish-Dosewallips). Agricultural lands also make up the lowest percentage (0.5 percent) of WRIA 16 and make up the highest percentage of WRIA 18 (Elwah-Dungeness). An analysis for road density in the region yielded an average road density of 4.3 miles per square mile (WDNR 2004).

Managed forestlands throughout this area are becoming increasingly fragmented by urban development, although some large commercial timber plantations remain on the western side of the Kitsap Peninsula and in eastern Jefferson County (Quilcene – Port Ludlow area of the Olympic Peninsula). Agricultural uses are common in the floodplains of the area.

Recreational, residential and limited urban development has resulted in some impact, especially along the marine shorelines. Most of the larger rivers drain from the Olympia National Park and USFS Wilderness; thus, many of the upper watersheds are substantially protected. However, timber harvest and the associated forest road construction occurred in some of the high Olympics in the South Fork Skokomish and Dungeness Basins. These forest practices were followed by severe landslide episodes (Bountry et al., 2002; WDNR 1997c). Private and State commercial timber plantations are present around the fringes of this Federal land, and occupy most of the foothills. Hydropower dams block anadromous fish access to the upper Elwha River (however these dams are slated for removal in 2008), and summer irrigation and groundwater withdrawals create problems in the lower Dungeness River.

Forest ownership and management. Approximately 40 percent of all lands in these WRIAs are in Federal ownership and the majority of these (representing 26 percent of all lands) are being managed for long-term preservation, primarily in national parks, national recreation areas, and wildernesses. Tribal lands represent about one percent of the region. State lands (primarily under management for timber production) represent 11 percent of all lands in the region, private lands represent 48 percent, and city/county lands represent less than 0.1 percent. The remaining Federal lands (one percent of all lands) are being managed by other agencies.

Land ownership varies considerably among the WRIAs of the region. The majority of WRIAs 16 (Skokomish-Dosewallips) and 18 (Elwah-Dungeness) (71 and 74 percent, respectively) and 29 percent of WRIA 17 (Quilcene-Snow) are in Federal ownership in Olympic National Park and Forest. In contrast, the Federal Government administers little or no forest land in WRIAs 14 (Kennedy-Goldsborough) and 15 (Kitsap); the vast majority of these WRIAs (89 and 80 percent, respectively) are in private ownership.

Approximately 41 percent of the forestlands in these WRIAs are in Federal ownership, one percent is in Tribal ownership, 12 percent are in State ownership, and 46 percent are in private or other ownership. A Federal or State preservation or limited management status covers approximately 41 percent of the forestlands in the region. Only about one percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately 11 percent of the forestlands and 46 percent of the forestlands are in private, county, city, or tribal ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 57 percent of the forestlands in the region. Existing HCPs cover the majority (86 percent) of the State-managed lands, and about 13 percent of the combined private, county, and city ownerships. WRIA 14 has the largest percentage of forest practices rules-covered lands (99 percent of all forestlands, 45 percent of which are covered by existing HCPs) and WRIA 18 has the lowest (22 percent of all forestlands, 33 percent of which are covered by existing HCPs). Most of the private forestlands in the region are found on and adjacent to the Kitsap Peninsula, especially in WRIAs 14 and 15.

Small, 20-acre exempt forest landowners make up about 2.2 percent of the forestlands and about 3.8 percent of the forestlands subject to forest practices rules in these WRIAs, based on the analysis by Rogers (2003). The small landowner parcels are mainly found in the lower elevation lands, especially on the Kitsap Peninsula and along the major rivers. The highest percentage (about 4.5 percent of the forestland) is in the Kitsap WRIA (15) and the lowest percentage (0.1 percent) is in the Skokomish-Dosewallips WRIA (16).

Approximately 4,879 stream miles occur on lands subject to forest practices rules in these WRIAs (Table 5). This represents 54 percent of all streams in the region. Approximately 3,134 miles or 64 percent of the 4,879 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be about five percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 5.5 percent (Rogers 2003).

Lunetta et al. (1997) isolated data from these WRIAs. Lunetta et al. (1997) reported that 11 percent of the RRRBs were classified as late seral stage. Almost 18 percent of the RRRBs were non-forested, primarily as a result of urban and agricultural development.

This area of the State has a smaller percentage of non-forested lands than other Puget Sound WRIAs described earlier in this section. Instead, these WRIAs are characterized by large areas of National Park and National Forest lands on the Olympic Peninsula and the generally reduced pace of urban and agricultural conversion relative to north and south Puget Sound. Thirty-two percent of the forests in the western Puget Sound WRIAs are in late seral condition[1], as compared to less than two percent within the Puget Lowlands. This reflects the extent of historical timber harvest within the Puget Lowlands. Thirty-eight percent of the Puget Lowlands were described as other forestlands, defined either as hardwood, brush, or clearcuts. This may reflect the regeneration of riparian areas as hardwoods following historic harvest.

In a separate photometric survey, Marshall and Associates (2000) looked at riparian buffers on private forestlands only, and determined that roughly 54 percent[2] of the riparian buffers on private forestlands were hardwood dominated (e.g., greater than 70 percent hardwoods). These two photometric assessments suggest that a substantial portion of the "other forestland" riparian zone is hardwood-dominated.

Sediment/mass wasting. In the Puget Lowlands, SRLSs are not a widespread problem; however, locally sensitive areas occur. Activity that loosens soils, increases hillslope gradients, removes trees and concentrates runoff can trigger landslides on steep gradients (WDNR 1998b; WSCC 1999d). These landslides can deliver both fine and course sediments to stream channels and aggrade channel beds (WDNR 1998b).

In contrast to the Puget Lowlands, the slow weathering rock formations and high mountains in the Olympics area have created long and steep hillslopes. These natural conditions raise the incidence of mass wasting (WDNR 1994a; WSCC 2003a), especially where forest fires have occurred. Extensive road construction and timber harvests on steep slopes are triggering hundreds of SRLSs. Mid-slope roads are particularly vulnerable. Although conflicting assessments exist concerning the downstream impact of these slides, the most recent assessment concluded that impacts were severe (WSCC 1999d). Hundreds of SRLSs, as a result of historic timber harvest and road construction on steep slopes, have been documented in the South Fork Skokomish River and Big Quilcene Rivers (WDNR 1994a; WDNR 1997b). In the Dungeness

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[1] 'Late Seral' Stands should not be confused with 'Old Growth Stands'. 'Late Seral' as defined by Lunetta et al (1997) means the conifer crown cover is greater than 70 percent and more than 10 percent of the crown cover in trees are greater than 21inches diameter breast height (dbh). Thus, "Late Seral" can include some mature second growth conifer stands.

[2] This study used regional definitions that overlap the regional definitions used herein. The actual figures used in this study were 51 percent for the 'South Puget Sound' Region, and 57 percent for the 'North Coast' Region. These two regions are roughly the same as the combined Olympic Coast, West Puget Sound and South Puget Sound regions as defined in this report. Marshall and Assoc. found relatively little variation in hardwood stand percentages on private lands throughout western Washington.

Basin, a sizeable portion of land is outside the National Park and wilderness area preserves, and some deep glacial deposits exist in the middle of the watershed (WSCC 1999d).

Large DSLSs are not common to these WRIAs. The Puget Sound Lowlands lack the steep long slopes, and the Olympic Mountains have relatively hard unweathered bedrock as a result of rapid geological uplift. However, the Olympic Mountains do contain a number of active large DSLSs in large alluvial and glacial deposits. For example, the Dungeness River has been severely impacted by three DSLSs (PSCRBT 1991). A number of DSLSs are located at or near the west Hood Canal shoreline, where deep glacial and alluvial deposits are being undercut by shoreline or river channel erosion. Highway placement, timber harvest, and residential development may have contributed to this problem. Several of these landslides were activated during a period of high precipitation in 1996, requiring closure of State Route 101 for seven months (WSCC 2003a).

In addition to the coarse sediment mentioned above, fine sediment from unpaved roads enters stream channels. Unpaved roads are wide spread on industrial forestlands, and to a lesser extent, in rural residential areas and recreational forestlands. Commercial forestlands throughout Washington State have extensive networks of unpaved roads, and these WRIAs are no exception. However, competent "hard" rock for road surfaces is readily available.

On the Kitsap Peninsula, within the Puget Lowlands, many rural unpaved roads in low gradient areas are not graded above the surrounding surface, but are sunken below the surface of the land. This makes the discharge of surface water impossible. During high rainfall, water flows down the road until there is a dip in the road gradient. Water and sediment are discharged at these points, often directly into a channel. Most of these roads are residential, and not subject to forest practices rules (WDNR 1998b).

Riparian/floodplain and wetland conditions. Most drainage basins within the Puget Lowlands are small and relatively low in gradient, thus they lack the water volume or energy to form wide floodplains. Many of the smaller floodplains, which do exist, have already been developed. Perched aquifers have contributed to freshwater wetlands in the headwaters of various drainages (e.g., West Kitsap watershed). These wetlands are being filled or impacted by adjacent residential developments (WDNR 1998b).

Heavy rainfall and relatively steep channel gradients in the Olympic Mountains result in "flashy" systems and relatively few small wetlands. Alpine lakes and bogs occur within the interior of the Olympic Mountains. With the exception of the Skokomish River System, floodplains are restricted to the lowest reaches of these rivers adjacent to marine waters. These floodplain areas were the most suitable (i.e., flat) for settlement, and towns and farms were frequently established there. Once established, the river channels were diked and levied for protection from flooding. The Skokomish River has a more extensive floodplain extending 14 miles inland. Most of this floodplain has been converted to agricultural uses, and much of the wetlands that once existed have now been drained or filled (WSCC 1999d; WDNR 1997b). Although, the valley has a history of flooding, a large influx of sediment from the upper south fork has occurred in the past 20 years, causing rapid aggradation of the riverbed and more frequent floods. A combination of historic forest practices and natural events have contributed to this bed-load influx (WDNR

1997b).

Channel/hydrology conditions. Within these WRIAs, peak stream flows have systematically increased over time due to land use activities including paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain on snow events in higher elevation clear-cuts (WDNR 1997b and 1997c; WDNR 1998b). The impact of residential development on peak flow is well documented in the West Kitsap Watershed Analysis in WRIA 15 (WDNR 1998b). Loss of forest canopies can substantially increase peak flow events due to rain-on-snow runoff. Snow accumulations, especially at high elevations, are substantially greater on unforested than on forested surfaces. This is primarily a concern with clear-cut timber harvest at elevations above 900 meters (approximately 3000 feet) in the Olympic Mountains (WFPB 1997).

The northeast coast of the Olympic Peninsula is the driest place in western Washington because it is located in the rain shadow of the Olympic Mountains. This has made the Port Angeles – Sequim area popular for residential, recreational and retirement development; however, this creates a high demand for water during the summer. Irrigation and municipal water withdrawals and residential ground water withdrawals have impacted surface flow in the lower Dungeness River, and, to a lesser extent, in the lower Elwha and small tributaries in the Port Angeles-Sequim area. However, irrigation actually improves summer flow in some smaller tributaries as a result of continuous groundwater recharge (WSCC 1999d).

The Puget Lowlands are relatively low in elevation, thus snow accumulation is rare. Furthermore, soil percolation is naturally high in most of this area. Groundwater withdrawal and increased peak flow may decrease surface flow during the dry season in urban areas. However in some areas of the Puget Lowlands, impervious surfaces such as paved roads, buildings, and lawns contribute to reduced soil percolation. The filling and degradation of freshwater wetlands has also increased peak flows in some areas (WSCC 1999d; WDNR 1998b).

Estuarine and nearshore habitat. The Puget Lowlands exhibit a complex network of roughly 1000 miles of marine and estuarine shorelines. Most of these estuaries are still present, but some level of modification or alteration has occurred in most of them. Failing septic systems is a common problem in many areas, leading to closure of shellfish beds. The more urbanized areas exhibit a wider range of problems from sedimentation, road surface runoff, industrial pollutants, and heavy metal contamination of the marine sediments (WSCC 2003 and 2003a).

Some of the rivers draining from the Olympic Mountains have well-developed estuaries (i.e., the Skokomish River), while others (i.e. Dosewallops, Elwha Rivers) have relatively abrupt transitions from freshwater to salt water. The Skokomish River Estuary has been impacted by a dike preventing tidal and floodwater circulation; however, the dike has recently been breached in places to allow more natural function (WSCC 2003a). Industrial pollution and the substantial reduction of late summer flow in the Dungeness River have contributed to the decline of eelgrass in the Dungeness estuary (WSCC 1999d).

Degradation of the near-shore environment has occurred in the southeastern areas of Hood Canal in recent years resulting in late summer marine oxygen depletion and significant fish kills. This problem was severe in 2003. Circulation of marine waters is naturally limited, and partially driven by freshwater runoff, which is often low in the late summer. However, human development has increased nutrient loads from failing septic systems along the shoreline, and from use of nitrate and phosphate fertilizers on lawns and farms. Shoreline residential development is widespread and dense in many places. The combination of highways and dense residential development has impacted both physical and chemical characteristics of the near-shore environment (WSCC 2003 and 2003a).

Large Woody Debris. The recruitment of LWD has been impacted by past riparian forest harvest and, on lands converted to other uses, the failure to re-establish these riparian forests following harvest. The retention of in-channel LWD has been impacted by its removal for navigational purposes, dikes and levee interference, debris torrents, and the historic practice of LWD removal as a misguided fisheries management tool. Large cedar logs were recently removed from Big Beef Creek (WDNR 1998b). Removal of newly recruited LWD from the Skokomish River for commercial timber has occurred in recent years (WDNR 1997b and 1997c).

Most of the stream channels in the Puget Lowlands are small to medium in size and do not require very large wood to achieve most LWD function. The existence and function of riparian buffers have been impacted by historic harvest of the riparian timber, regeneration of those stands as hardwoods, and agriculture and urban development (WDNR 1995a, WDNR 1998b). Some channels in this region are exceptionally sensitive to the loss or removal of LWD, because they cross deep deposits of unconsolidated glacial material. Channels flowing across such deposits often lack bedrock, boulder and large cobbles necessary to armor the channel bed; and therefore, the loss of LWD can lead to rapid channel incision and accelerated bank failures (e.g. Big Beef Creek, WDNR 1998b). Other channels such as those in the South Fork Skokomish basin are in moderately good condition in terms of current and future in-channel LWD. Those areas with a high LWD recruitment hazard in the South Fork Skokomish basin have very good prospects for future improvement for LWD (WDNR 1997b and 1997c). In the Kennedy Creek watershed, 68 percent of the riparian areas of fish bearing streams were found to have the ability to supply an adequate amount of LWD in the near term and that percentage will likely increase over time, given the riparian protections that are now in place (WDNR 1995).

In the Olympic Mountains, landslides are the primary means of LWD recruitment, although riparian adjacent recruitment is still important. Steep gradients and precipitation result in high-energy peak flows. Thus, very large conifer LWD, with attached rootwads, is required to achieve LWD function in these larger channels. Confinement of valley floor river channels by diking and levees accelerates downstream transportation of LWD during peak flows (Bountry et al., 2002).

Water Quality. In the upper watersheds of the Olympic Mountains, data on water temperature is sparse, but water temperature problems are not expected (WSCC 1999d; 2003 and 2003a). A few water temperature problems have been documented along the coastline of WRIA 18 (Port Angeles-Sequim area, e.g. Dry Creek, (WDOE 1998)). Within the Puget Lowlands, elevated water temperature problems are more common, but variable from drainage to drainage. Agricultural land use and the associated lack of riparian buffers are the key reason for elevated temperatures, although lakes, wetlands and residential development can be contributors in some areas (WSCC 2000g; 2002a; 2002b; 2003; 2003a). In WRIA 17, high temperature has been documented in Chimacum Creek, the Little Quilcene River and tributaries, Tarboo Creek, and Thorndike Creek. In WRIA 15, Big Beef Creek and Gamble Creek have had high temperatures (WDOE 1998).

A few low dissolved oxygen problems have been noted, primarily associated with low stream velocities through agricultural lands. Many stream channels have not been monitored for water quality (WSCC 1999d; 2000g; 2002a; 2002b; 2003a).

Forest roads and harvest activities, as well as dikes and levees downstream, have increased aggradation of sediments and peak flows in the Skokomish River (WRIA 16), Dungeness River (WRIA 18), and to some extent the Big Quilcene River (WRIA 17) (Barreca 1998). These three rivers are also impaired due to low instream flow from water withdrawals or diversions. Fish and wildlife forested habitat owned by Simpson Timber in the Skokomish watershed is now protected by a Habitat Conservation Plan (Simpson Timber Company 2000).

Hydropower

Hydropower storage dams are operating on the Elwha River and the North Fork Skokomish River, and both dams limit downstream gravel transport (WSCC 1999; WSCC 2003b). The Elwha River dams block anadromous fish access to 70 miles of potential habitat. In the 1990's, the National Park Service began a long term process to remove the Elwha River dams and those actions will be the subject of future ESA section 7 consultation with NMFS. On the North Fork Skokomish River, historical anadromous fish access to the dam sites is uncertain; however, the hydropower plant diverts flow directly to Hood Canal, and thus bypasses a substantial portion of the flow from 17 miles of habitat. Other small hydropower projects and municipal water diversions may have localized impacts to the aquatic environment (WSCC 1999; WSCC 2003b).

Primary adverse effects attributable to hydropower development in the West Puget Sound Region are found in the Skokomish River watershed. Two dams completed in 1926 and 1930 at RMs 19.6 and 17.3, respectively, represent the upper limit of salmonid migration in the North Fork of this river. After the construction of the North Fork dams, virtually all flow was diverted from the system at the lower dam until 1988. Thereafter, operations were revised to supply 30 cubic feet per second (cfs) below the project (WDFW and PNPTT 2000). Hood Canal summer chum salmon are believed to have been extirpated from the Skokomish River system in the late 1960s or early 1970s. WDFW and PNPTT (2000) concluded that there is currently no evidence of a viable summer chum stock in the system. The lack of adequate migration and spawning flows in the North Fork of the Skokomish River after the construction of the two dams in the basin is believed to be the main reason for the lack of chum presence there.

The FERC and NMFS completed consultation on the operation of Cushman Dam on the North Fork Skokomish River on February 24, 2004. That consulation concluded with a "no jeopardy" determination and conditions in the FERC license relating to changed operations. Changes in dam operations in the North Fork of the Skokomish River provide improved flow regimes for migrating, spawning, and rearing anadromous fish in river reaches below the dams. General habitat recovery objectives to reduce the adverse effects of dam operation include (1) providing free and unimpeded access to migrating adult and emigrating juvenile chum through elimination of existing human caused barriers and maintenance of adequate flow, and (2) improving the stability, quantity, and quality of spawning habitat by providing adequate stream flow.

Summary of Factors Affecting Covered Species in these WRIAs

From a forest management perspective, data suggest that riparian areas on Federal lands in the Olympic Mountains have seen only limited harvest, and are now substantially protected (WDFW, 2003). Gradual increased restrictions on riparian timber harvest over the past 30 years places private forestlands on a pathway to recovery, although that pathway is longer for hardwood stands in the Puget Lowlands. Urban and agricultural impacts on riparian buffers, while significant, are less extensive for these WRIAs than the other Puget Sound regions.

Additionally, these WRIAs present habitat limitations from things other than forestry. Those things include flow alteration, water appropriation, inadequate stormwater management (including both point and non-point sources), failing shoreline septic systems, agriculture sediment and pollution inputs, bank armoring, culverts and other migration barriers, lack of LWD, erosion associated with channelization, timber conversion from conifers to hardwoods, land conversion from forest to urban or agriculture, reduced riparian recruitment, dredging, filling, over-water structures, increased road densities, diking, LWD removal in lower floodplains, mainstem blocking dams, floodplain encroachment, fish screens, irrigation withdrawals, and loss of eelgrass in estuary (SSHIAP 2004). All of these limiting factors combine to impair the baseline condition in this region.

Primary factors limiting the survival and recovery of the Skokomish Chinook population are: inadequate migration and spawning conditions; insufficient conditions and capacity for incubation and juvenile rearing; mortality during incubation and insufficient capacity and condition of estuarine areas. Hydropower impacts and sediment-routing-disruption are the primary limiting factors to recovery of this population to a viable status. Adult access to spawning areas, spawning area condition, and the quality of spawning areas for incubation are all adversely affected by these two factors. Degraded floodplain and channel structure processes, estuarine habitat loss and degradation, and degraded riparian forests are also significant limiting factors to population survival and productivity.

Primary factors limiting the survival and recovery of the Mid Hood Canal Chinook population are insufficient capacity and condition of estuarine areas, insufficient conditions and capacity for incubation and juvenile rearing, inadequate migration and spawning conditions, and insufficient rearing capacity and conditions in nearshore and marine areas. Degraded estuaries for the rearing of ocean-migrating Chinook fry is a predominant limiting factor to recovery of the mid-Hood Canal Chinook population. Degraded riparian forests, dysfunctional floodplain and channel structure, and nearshore and marine habitat loss and degradation are also significant limiting factors to population survival and productivity.

The observed reductions in the numbers of Hood Canal summer chum salmon in the region are the result of the combined impacts of a number of factors (Johnson et al., 1997; summary below from WDFW and PNPTT 2000). Habitat degradation and loss from a variety of sources, including forest practices, road building, residential construction, stream flow alteration, diking, and channelization, have had major negative effects on summer chum streams throughout the ESU. Climatic factors, including a shift since 1977 to warmer, dryer conditions during the September summer chum spawning period, and higher flows during the October through March incubation period, are thought to have had moderate to major negative effects on summer chum productivity. Competition or predation impacts posed by other salmonid species have had moderate, negative effects on summer chum. Finally, over-harvest in Canadian per-terminal and U.S. terminal area commercial fisheries directed at other species have had moderate to major negative effects on listed summer chum abundance and production.

2.1.3.4.5 Lower Columbia River Watershed Resources Inventory Areas. WRIAs 25, 26, 27, and 28 include the Kalama, Grays, Elochoman, Cowlitz, Coweeman, Lewis, Salmon Creek, and Washougal River Basins, as well as other smaller tributaries. Portions of Wahkiakum, Skamania, Cowlitz, and Clark Counties are contained within the Lower Columbia River area. The Lower Columbia area lies within the Southern Cascades and Willapa Hills physiographic provinces and encompasses all of the Portland Basin physiographic province (Lasmanis 1991). Elevations range from sea level to over 14,000 feet atop Mount Rainier. The effects of past and present actions in these WRIAs are relevant to the biological requirements for all Columbia Basin ESUs of salmonids (listed and unlisted) and most of the unlisted species included in this consultation (including both species of sturgeon).

Habitat degradation in these WRIAs, especially as a result of sedimentation, fragmentation, simplification, and simple loss of habitat from hydropower development, are leading habitat factors affecting the status of the species in this portion of the action area. Several recent actions are underway or in preparation to address the effects of hydropower facilities and their operation on the Cowlitz and Lewis Rivers. The area is subject to forest harvest on extensive private lands and intense agricultural development in the lower main-stem and lower reaches of tributaries.

Rural residential development, commercial development, and transportation corridors have impaired channel stability and habitat diversity in the lower river main-stems (NMFS 2004c). Sedimentation in these reaches is related to basin-wide forestry practices. The lack of a “hydrologically mature” forest, high amounts of impervious surface, and high road densities all impair watershed processes (NMFS 2004c). Channel straightening, artificial confinement, the loss of stable, in-stream, large woody material, and changes in stream flow have reduced habitat diversity. Anthropogenic responses to the effects of the 1980 Mount St. Helens eruption on the natural environment (e.g., timber harvest and road building in areas that receive rain-on-snow) have further impaired hydrologic processes. Increased waterfront development has also modified riparian areas and near-shore processes. Riparian function has been compromised by the loss of large wood, stream-bank instability, diminished floodplain function, reduced in-stream flows, and by the disruption of nutrient exchange and hyporheic flows.

As a result of these myriad activities, 70 percent of the forest in this watershed is young-aged (NMFS 2004c). Agricultural development near the mouth of the river has reduced backwater habitats in the tidal influence zone, significantly reducing rearing habitat indicating that favorable microhabitats be limited in distribution. NMFS (2004c) determined that channel morphology and flow were the primary anthropogenic limiting factors.

The NMFS has completed 17 formal ESA section 7 consultations in these WRIAs since listing the majority of the covered species in 1999. This number includes one programmatic consultation with the United States Forest Service, Gifford Pinchot National Forest for 15 activities that could influence the existing condition of the environmental baseline in the LCR presently and for the foreseeable future during the term of the proposed ITP. The rest of these consultations include individually small but beneficial construction actions (e.g. replacing culverts improving habitat access) as well as small actions with adverse effects (e.g. bank stabilization, road construction, pier and boat ramp construction). None of these consultations concluded with a "jeopardy determination," and all included reasonable and prudent measures to minimize the extent of anticipated take for each action. The following is a brief description of conditions resulting from myriad historic non-Federal actions, and the Federal actions summarized above.

Hydrology

The Cowlitz River drains much of the Lower Columbia region and flows into the Columbia River at the town of Longview. Other rivers in the region include the Grays, Elochoman, Kalama, Lewis, Salmon and Washougal, all of which are tributary to the Columbia. Peak flows are driven by large magnitude rainfall events in lower elevation basins such as the Grays and Elochoman rivers. Rain and rain-on-snow precipitation events produce peak flows in the remaining basins. Because of its origins on Mount Rainier, the Cowlitz River sometimes experiences significant snowmelt peak flows during the spring. Low flows occur during the late summer and early fall. Based on the DNR stream hydrography GIS coverage, there are approximately 29,645 stream-miles (both fish-bearing and non-fish streams) in these WRIAs, with an average stream density of 6.18 stream miles per square mile.

Habitat

Land cover and use. Forestland makes up approximately 85 percent of these WRIAs, ranging from 59 percent in the Salmon-Washougal WRIA to 90 percent in the Lewis WRIA. Agricultural lands comprise six percent of the region, and they are particularly prevalent in the river valleys of the Salmon-Washougal WRIA. Residential-commercial lands make up two percent of the region overall, but are also particularly prevalent in the Salmon-Washougal WRIA, making up 14 percent. Average road density in the region is 4.6 miles per square mile (WDNR 2004).

Forest ownership and management. Approximately 37 percent of the forestlands in the Lower Columbia area are in Federal ownership, almost none (less than 0.1 percent) are in Tribal ownership, 12 percent are in State ownership, and 50 percent are in private or other ownership. A Federal or State status of preservation or limited management covers approximately 27 percent of the forestlands in the region. Approximately 10 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately 12 percent of the forestlands, and 50 percent of the forestlands are in private, county, or city ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 62 percent of the forestlands in these WRIAs. Existing HCPs cover the vast majority (85 percent) of the State-managed lands, and a small portion (three percent) of the private, county, and city ownerships.

The overall percentage of forestlands subject to the State forest practices rules ranges from 55 percent in the Lewis WRIA to almost 100 percent in the Grays-Elochoman WRIA. The overall percentage covered by an HCP ranges from 15 percent in the Cowlitz WRIA to 31 percent in the Salmon-Washougal WRIA.

Small, 20-acre eligible forest landowners make up about 1.4 percent of the forestlands and about 2.3 percent of the forestlands subject to forest practices rules in the Lower Columbia River area, based on the analysis by Rogers (2003). The small landowner parcels are mainly found in the lower elevation lands, especially along the major rivers. The highest percentage (about 2.7 percent of the forestland) is in the Salmon-Washougal WRIA and the lowest percentage (0.7 percent) is in the Cowlitz WRIA.

Approximately 18,647 stream miles occur on lands subject to forest practices rules in these WRIAs. This represents 63 percent of all streams in the region. Approximately 9,794 miles or 53 percent of the 18,647 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be about 1.2 percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 1.9 percent (Rogers 2003).

Sediment/mass wasting. The coastal hills in WRIA 25 and the western edge of WRIA 26 are very sensitive to SRLS and debris torrents; with all the same problems of highly weathered and fractured rocks discussed in these WRIAs section. The hills in Grays River and Elochoman River basins have naturally high sediment backgrounds, but forest practices have exacerbated the problem (WSCC 2002d; WDNR 1996e).

The Cascade foothills and mountains are moderately vulnerable to landslides. Steep slopes tend to be greater in length, and thus, the events can be more severe than in the coastal hills. Forest roads, and to a lesser extent, clear-cut harvesting on steep slopes helped trigger most of these landslides. Lands prone to SRLS are often managed for forestry, because they are unsuitable for most other uses. Watershed analyses conducted in the Cascade Mountains suggest a moderate to severe vulnerability to SRLS and debris torrents (WDNR 1993c; 1994e; 1994f; 1996e).

Fine sediment from the mudflows and ash fall from the 1980 eruption of Mt. St. Helens continue to flush into the rivers near the mountain. Recovery in the North Fork and South Fork Toutle Basins is still far from complete. Partial or substantial recovery has occurred elsewhere. Sediment has filled the sediment retention structure on the North Fork Toutle River, and it is unclear what additional actions will be taken to abate this problem.

A number of the watershed analyses in the Lower Columbia River area note a high frequency of DSLS (WDNR 1994e; 1996e). It is unclear whether this is a regional feature, or simply a result of a thorough search for these formations in the watershed analyses conducted within this region. Many DSLS have been dormant for centuries, but could potentially be activated by forest practices by removing weight from the toe of the landslide, redirecting flow into the toes such that accelerated erosion occurs, or modifying the channel inputs such that channel incision occurs. However, landslides are not currently a significant factor in the Cowlitz Valley.

The underlying geology and heavy rainfall in the coastal foothills contribute to sensitivity to road surface erosion. Unpaved forest and rural residential roads require significant maintenance to minimize sediment delivery to channels. In some areas, hard rock for road surfacing is difficult to find and roads must be surfaced with the next best available material (WDNR 1996e).

Riparian/floodplain and wetland conditions. Historic timber harvest removed most riparian buffers. In these WRIAs, timber harvesting started in the early 1860s and was mostly completed by the 1970s. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zones along many agricultural areas are now dominated by alder, canary grass, and blackberries, resulting in reduced shade and LWD recruitment. It is difficult for native conifer to re-establish in buffers with these characteristics. A photometric study by Lunetta et al. (1997) suggests that functional riparian buffers in agricultural and urban areas are substantially lacking or inadequate.

Wetlands were likely historically extensive in the lower gradient river valleys near the Columbia River. Farmers in the late 1800s started draining and diking most of this land. Remaining wetlands are limited and should be a priority for restoration and preservation (WSCC 2000c; 2001b).

The 1980 eruption of Mt. St. Helens released mudflows that destroyed the riparian forests along the entire lengths of the North Fork, South Fork, and mainstem Toutle River, and the Muddy River and Pine Creek tributaries of the Lewis River. In addition, extensive damage occurred in the blast zone north of the mountain, including most of the Green River Basin and small tributaries to the Cowlitz, Cispus, Lewis and North Fork Toutle basins. While some recovery has occurred, the full recovery of riparian stands in the North and South Fork Toutle River will time. The remaining wetlands and side channels in the North Fork, South Fork, and mainstem Toutle River and lower Cowlitz River have filled with mudflow deposits or dredge spoils. Extensive diking in the lower Cowlitz and the lower Coweeman has resulted in permanent confinement of the channel (WSCC 2000c).

Diking, channelization, wetland draining and related activities have occurred in other floodplains throughout this region. Floodplain impacts have varied in intensity from efforts to protect farmlands on the Cowlitz River above Cowlitz Falls (WSCC 2000c), to systematic floodplain development and flood control activities in the urban areas of Clark County (WSCC 2001c). Urban development was still occurring in the floodplains of the Washougal River (WSCC 2001c). Smaller floodplains in smaller drainages are often confined as a result of road or railroad construction (WSCC 2000c).

Channel/hydrology conditions. This region has seen significant modification to sediment and water routing as a result of dam construction. Three dams were constructed on the Cowlitz

River, which significantly modified gravel supply, resulting in a decline in the quality of spawning substrate. Three hydropower dams were also built on the Lewis River, again modifying the hydrology and gravel supply. The mainstem of the Lewis River below the lowest dam is largely bedrock and boulders. Flow fluctuations from hydropower peaking can cause stranding and fish kills (WSCC 2000a).

Loss of forest canopies can substantially increase peak flows due to rain-on-snow events. The Cascade Range within this region has extensive areas above 1200 feet (WFPB 1997). Clearcuts above this elevation can accumulate significant snow packs that would not occur in forested areas.

The Mt. St. Helens eruption destroyed approximately 230 square miles of forests to the north of the mountain. While much of this area should now be re-establishing hydrological maturity, rain-on-snow events have impacted the channels in this zone over the past twenty years.

The extensive network of forest roads may contribute to increased peak flows. Road ditches may act as an extension of the channel network, accelerating runoff and increasing peak flows (Whemple 1994). The existence and severity of road network effect is still subject to research and debate.

Estuarine and nearshore habitat. The impacts to the lower Columbia River are an accumulation of upstream activities in Washington, Oregon, Idaho and British Columbia. The most significant modification of fish habitat in the Columbia River results from the extensive network of upstream hydropower dams. These dams changed seasonal flow, sediment discharge, water temperature, fish communities and water chemistry. Along the Columbia River shorelines of this region, diking and filling as a result of urban and agricultural development, has reduced the sloughs and wetlands that likely provided rearing and over-wintering habitat for juvenile salmon. Road and railroad beds along the Columbia River have filled or cut off access to wetlands and side channels (Schaller et al., 2002).

Large woody debris. Past riparian harvest has affected the recruitment of LWD. However, long-term recruitment potential of LWD is good throughout the forested areas in the region. The retention of in-channel LWD has been affected by removal of LWD for navigation, dikes and levee interference, debris torrents, splash damming, and as the result of state regulatory requirements. The generally frequent occurrence of debris torrents make retention of LWD a significant issue.

LWD is generally insufficient in these WRIAs. Low amounts of LWD is attributable to riparian timber harvest, splash dams, agricultural and urban conversion of riparian habitat, and stream cleanouts. The mudflows that resulted from the Mt. St. Helens volcanic eruption and the ensuing flood control responses completely removed the riparian zone in the North Fork Toutle, South Fork Toutle, mainstem Toutle and the lower Cowlitz River; and recovery has been slow (WSCC 2000c; 2000d; 2001b; 2002d).

Fifty five percent of riparian stands on private lands in these WRIAs are dominated by hardwoods (Marshall and Associates 2000). Hardwoods do not grow to the size of conifer, and rot quickly; thus, they are not as useful as conifers for LWD. However, hardwoods, especially alder, are an important source of nitrogen, which may be more important in the small channels that don't readily flush leaf-litter (Wipfli and Gregovich 2002).

Fish passage and barriers. Statewide, thousands of miles of fish channels have been rendered partially or completely inaccessible to fish, as a result of road culverts and other water crossing structures (WSCC 2000c; 2000d; 2001b; 2002d). This fish passage problem occurs in these WRIAs and removes potential fish habitat from fish production. In the past decade, fish passage through forestry, agricultural and urban road culverts has been an area of renewed interest and directed funding. See below for a discussion of specific hydropower facilities in this region.

Water quality. Freshwater temperatures routinely exceed state water standards at low elevations near the Columbia River and the lower Cowlitz River and are consequently listed on the state 303(d) for water temperature. A moderate number of water temperature readings higher than state water quality standards have been documented even on moderate sized channels in private lands. A variety of factors may explain these, including debris torrent damage, recent harvest, naturally wide channels, and lack of conifer regeneration. The Cowlitz River below the Mayfield Dam benefits from cool water drawn from below the thermo-cline in Mayfield Lake, thus water temperatures are in compliance for a considerable distance downstream.

In WRIA 25, portions of the Columbia River, Germany Creek, Abernathy Creek, Elochoman Creek, Wilson Creek and Grays River at times have not met water quality standards for temperature (WDOE 1998). The Elochoman River, Abernathy Creek, Germany Creek and especially the Grays River have been impacted by sedimentation from forest practices (Simms 1997).

Many creeks in WRIA 26, including the Cispus and Coweeman Rivers and some of their tributaries have had temperature exceedances. In WRIA 27, temperature exceedances have been documented in the Kalama River, East Fork Lewis River, Lewis River, and a few tributaries in the Gifford Pinchot National Forest near Mount St. Helens (WDOE 2004). Several streams in this WRIA have in-stream flow or fish habitat impairments (WSCC 2000d).

In addition to the Columbia River in WRIA 28, high temperatures have been recorded in the Salmon Creek and Burnt Bridge Creek watersheds (WDOE 2004). Many creeks have documented fish habitat or instream flow impairments (WSCC 2001b).

Chemical use in forestlands is substantially limited to herbicide applications to suppress alder, maple, and brush competition during early phases of conifer forest regeneration. There are no regional factors to suggest that impacts from herbicides would be different from other regions in Washington State. The use of forest fertilizers and septic tank discharges were identified as the causes for eutrophication in Silver Lake, a large lake in the lower Cowlitz Valley (WDNR 1999a).

Hydropower

Impacts of hydropower development have been the primary limiting factor for several populations within this ESU. Hydropower impacts include passage obstruction, flow effects, and habitat inundation and have resulted from hydropower development in the Lower Columbia mainstem and tributaries. These limiting factors and threats affect spawning, juvenile survival, and migration and increase susceptibility to disease, predation, and contaminants. Hydropower impacts in the Lower Columbia Chinook ESU have been greatest on spring Chinook, where several populations have been virtually extirpated as a result.

The construction of the Cowlitz and Lewis River dams constitute the two largest losses of anadromous fish access in western Washington State. In both systems, the loss of natural fish production was compensated with the construction of hatcheries, a common practice during 1940s and 1950s when these dams were constructed. Over 300 miles of accessible fish habitat were lost above Mayfield Dam on the Cowlitz, and roughly 150 miles above Merwin Dam on Lewis River. In both cases, 80 to 90 percent of the production potential had been lost (WSCC 2000c; 2000d).

In March 2004, NMFS and FERC completed ESA section 7 consultation on the relicense of the Cowlitz River Hydroelectric Project. That consultation concluded with a "no jeopardy" determination and included license conditions to refine downstream and upstream fish passage within the Cowlitz River project. The action includes minimum instream flows, disease management, and other provisions. In contrast, the dams on the Lewis River remain a total blockage to anadromous fish use (WSCC 2001b). However, NMFS and FERC have concluded a settlement agreement that would result in fish passage above the dams, and the relicense action will be the subject of a separate ESA section 7 consultation, presently underway. That consultation should address extant problems with passage.

Summary of Factors Affecting Covered Species in these WRIAs

The five main limiting factors for these WRIAs are increased sedimentation (affecting egg incubation and spawning), loss of habitat diversity and channel stability (affecting spawning, primarily first year summer rearing, first year to one-year old winter rearing, and one-year old summer rearing), increased temperature (affecting adult migration, pre-spawning adult holding, spawning, and egg incubation), barriers to passage (hydropower development), and artificial (hatchery) propagation (affecting ecological interactions with wild fish and genetic introgression in natural stocks).

Many habitat features essential to the long term survival of Chinook, coho, steelhead, and chum salmon populations have been altered or degraded within the range of the ESUs in this region. Estimates of current stream capacity to produce Chinook salmon relative to historical capacity in most of the Washington portion of the LCR Chinook ESU average 32 percent for spring Chinook, 58 percent for tule fall Chinook, and 93 percent for bright fall Chinook (LCFRB 2004). Lower Columbia River steelhead currently attain approximately seven to nine percent of their target growth rate (Myers et al., 2004). In their preliminary report, Fisher and Hinrichsen (2004) estimated a geometric mean of the aggregate number of CR chum salmon in two index areas (Grays River and Hamilton and Hardy creeks) equal to 1,776 during 2001-2003 compared to 2,114 in 1996-2000, a 16 decrease. The slope of the aggregate population trend decreased 1.5 percent (from 1.02 to 1.00) when the data for 2001-2003 were added to the 1990-2000 series.

2.1.3.4.6 Middle Columbia River Watershed Resource Inventory Areas. WRIAs 29, 30, 31, 37, 38, and 39 include the White Salmon, Klickitat, and Yakima River Basins, as well as other smaller Columbia River tributaries. Portions of Skamania, Klickitat, Yakima, and Benton Counties are contained within these WRIAs. This area lies within the Columbia Basin physiographic province (Lasmanis 1991) that covers nearly the entire southeast quarter of Washington. Elevations range from approximately 200 feet along the Columbia River to over 12,000 feet atop Mount Adams. The effects of past and present actions are relevant to the biological requirements for all listed and unlisted middle and upper Columbia River ESUs of salmonids and possibly both species of sturgeon.

NMFS completed 25 formal ESA section 7 consultations in these WRIAs since listing the majority of the covered species in 1999. This number includes one programmatic consultation with the United States Forest Service, Gifford Pinchot National Forest for 15 activities that could influence the existing condition of the environmental baseline in the MCR presently and for the foreseeable future during the term of the proposed ITP. Other typical consultations in this area include several with the United States Army COE for permitting actions. These actions included individually small construction actions with beneficial effects (e.g. replacing culverts improving habitat access) as well as some with adverse effects (e.g. bank stabilization, road construction, pier and boat ramp construction). Bonneville Power Administration consulted twice for fish passage improvement projects while BIA consulted twice on flood control actions. Finally, the Federal Highway Administration consulted six times for bridge replacement and road construction or maintenance actions. None of these consultations concluded with a “jeopardy determination,” and all included reasonable and prudent measures to minimize the extent of anticipated take for each action. In addition, NMFS issued ESA section 10 ITPs for HCPs by the Chelan and Douglas County Public Utility Districts (PUDs) covering operations at three hydroelectric facilities. For these HCPs, NMFS completed ESA section 7 consultations and made “no jeopardy” determinations.

The following is a brief description of conditions resulting from myriad historic non-Federal actions and the Federal actions summarized above.

Habitat

Land cover and use. Forestland makes up approximately 41 percent of these WRIAs. Shrub-land and grassland comprise about 38 percent. Agricultural lands make up 17 percent and the remaining four percent consist of residential/commercial, water and wetlands, and ice, snow, and bare rock. The percent forestland within each WRIA varies considerably, ranging from a low of nine percent in the Rock-Glade WRIA (31) to a high of 93 percent in the Wind-White Salmon WRIA (29). An analysis for road density in the region yielded an average road density of 2.9 miles per square mile (WDNR 2004).

Forest ownership and management. Approximately 26 percent of all lands in these WRIAs are in Federal ownership and portion of these lands (about five percent of all lands) are being managed for long-term preservation, primarily in national parks, wildernesses, and national recreation areas. Tribal lands represent a substantial portion of the region (about 19 percent). State lands represent 10 percent of all lands in the region, private lands represent 34 percent, and city/county lands represent much less than one percent.

The WRIAs differ markedly in their ownership. The upper Klickitat and most of the Lower Yakima WRIAs are inside the Yakama Indian Reservation. Much of the remainder of the Lower Yakima WRIA is in U.S. Department of Defense (Yakima Training Center) and Department of Energy (Hanford) Reservations. Most of the Naches, Upper Yakima, and Wind-White Salmon WRIAs are in National Forest System or State land ownership. The Rock-Glade WRIA is almost entirely private lands with scattered State-owned sections.

Approximately 42 percent of the forestlands in these WRIAs are in Federal ownership and 21 percent are in Tribal ownership. Overall, lands covered by the forest practices rules represent approximately 35 percent of the forestlands in the region. Existing riparian HCPs cover none of the State-managed lands (although an HCP relating to some wildlife covers 90 percent of the State lands in the region), but 11 percent of the combined private, county, and city ownerships. WRIA 31 (Rock-Glade) has the largest percentage of forest practices rules-covered lands (94 percent of all forestlands, none of which are covered by existing HCPs) and WRIA 38 (Naches) has the lowest (13 percent of all forestlands, 34 percent of which are covered by existing HCPs).

Most of the private forestlands are located in Klickitat, Upper Yakima, and the Wind-White Salmon WRIAs, generally at lower to middle elevations. State forestlands managed for timber production are located primarily in WRIAs 29, 30, and 39.

Small, 20-acre eligible ownerships make up less than 0.1 percent of the forestlands and about 0.2 percent of the forestlands subject to forest practices rules in these WRIAs, based on the analysis by Rogers (2003). Of these, the highest percentage (about 0.2 percent of the forestland) is in the Wind-White Salmon WRIA (29) and the lowest percentage, with no identified parcels, is in the Rock-Glade WRIA (31).

Lands covered by the forest practices rules include approximately 5,290 stream miles, or 28 percent of the stream miles in the mid-Columbia River. Approximately 4,594 miles or 87 percent of the stream miles are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre eligible forest landowner parcels in this region is estimated to be less than 0.1 percent and the percentage of all fish-bearing streams on small, 20-acre eligible forest landowner parcels is about 0.3 percent (Rogers 2003).

Sediment/mass wasting. Altered hydrology and channel simplification in the MCR have limited gravel substrates in many areas of the Yakima watershed. In some places, substrate is degraded by significant presence of fine sediments, and in other areas specifically from altered hydrology (e.g. Tieton River) and channel simplification (WSCC 2001d). For example, Dry Creek (a tributary to the Wind River) experiences excessive bed-load transport from conditions resulting from historic riparian harvest and the removal of LWD during stream clean out projects. Other streams have also been impacted by increased sediment load resulting from timber harvest and the loss of riparian cover (e.g., Youngman, Trout, Crater, Compass, and Layout Creeks within the Wind Basin). A number of landslides have occurred within the Wind River Basin and other streams (e.g., Rock Creek) associated with timber harvest and a gas pipeline (WSCC 2003b).

Turbidity from road runoff, logging, and land development has impacted various streams within this region (e.g., Nelson Creek, Carson Creek, Little White Salmon River and Jewett Creek, WSCC 2003b, and Little Klickitat and Swale Creek within the Klickitat drainage, WSCC 1999g). Within the Klickitat drainage, naturally generated glacial silt from Mount Adams also contributes significantly to sedimentation and turbidity in the watershed's streams (WSCC 1999g).

Riparian/floodplain and wetland conditions. Impaired riparian function has resulted in increased water temperature, loss of bank stability, loss of in-stream cover, and loss of LWD recruitment to streams. Riparian function is impaired in much of the Yakima basin by: (1) removal of riparian vegetation, (2) structures such as dikes, roads, and railroads, (3) channel incision, drains, and channelization that lowers the water table in riparian areas, (4) altered hydrology that either dewaters riparian zones or increases and/or changes timing of peak flows, and (5) cattle grazing (WSCC 2001d). Within the Columbia River, the main-stem habitat has been reduced, for the most part, to a single channel, floodplains have been reduced in size, and off-channel habitat features have been lost or disconnected from the main channel (Mainstem/Systemwide Habitat Summary 2002).

Salmonid access to productive side-channel habitats has been lost and the productivity of floodplain areas has been reduced in much of these WRIAs (e.g., Wapato, Naches, Yakima, and Wind Rivers). Floodplain function has been impacted by: (1) dikes, levees, roads and railroads that have constricted floodplain extent, (2) extensive mining within the floodplain, (3) channel incision that has disconnected the channel from the floodplain, and (4) channelization and construction of drains that eliminate or interrupt hyporheic or superficial side-channel flow (WSCC 2000e, 2001d, 2003b).

Channel/hydrology conditions. Within the Columbia main-stem, the natural hydrograph has been altered by dams, with decreasing spring and summer flows and increasing fall and winter flows. This alteration has affected channel conditions such as floodplains, off-channel habitat, LWD, and water velocities (Mainstem/Systemwide Habitat Summary 2002).

Within the Yakima Basin, the loss of channel complexity (e.g., LWD), cover, bank stability, and presence of pools has adversely affected spawning and rearing habitat (WSCC 2001d). The hydrograph in the Yakima River basin is aggressively altered by BOR operation of the Yakima River System. BOR is presently consulting with NMFS on the operation and maintenance of the Yakima River system. In the lower White Salmon River, Condit Dam has resulted in the lack of coarse substrate for spawning, a lack of pools and channel complexity (due to lack of LWD), and low flows (WSCC 2003b).

Large woody debris. The amount of LWD is reduced in the river as the result of major channel modifications caused by hydropower (affecting floodplain and off-channel habitat, fluctuating flows and water velocities), as well as adjacent land uses on the Columbia River main-stem (Mainstem/Systemwide Habitat Summary 2002). The loss/removal of LWD affects habitat, particularly in tributaries, such as Rattlesnake Creek (White Salmon River). The lack of LWD causes decreased substrate roughness and increased stream flow energy, which then washes-out the already limited streambed gravels, increases bank erosion, and increases channel incision.

Furthermore, these effects have reduced floodplain connectivity, and may reduce summer baseflows (WSCC 2003b). By contrast, the Naches Pass and Quartz Mountain watersheds have dense, mature conifer stands in riparian areas. These provide adequate LWD recruitment (WDNR 1994f, 1995d).

Fish passage and barriers. Within the Columbia River, hydropower operations have resulted in either complete or partial fish passage barriers both up and downstream. Power operations have also affected fish movement through reservoirs by stranding fish in shallow areas and cutting off important spawning areas in tributary streams during draw-downs (Mainstem/Systemwide Habitat Summary 2002).

Adult and juvenile salmonids have been precluded from historic spawning and rearing habitats. Barriers in the Yakima and Wind basins have resulted from irrigation diversions (e.g., Toppenish and Ahtanum Creeks within the Yakima), dams at major storage reservoirs (e.g., Tieton, Bumping, Cle Elum, Keechelus, and Kachess dams within the Yakima; Hemlock Dam within the Wind; Condit Dam within the White Salmon), and by forest road culverts (e.g., Youngman and Oldman Creeks in the Wind Drainage, WSCC 2003b). Productive side-channel habitats have been blocked to fish by structures that constrict floodplains. Natural barriers (deep canyons, falls and cascades) and man-made barriers (e.g., fishway/tunnel complex at Castile Falls and numerous road culverts) prevent access of anadromous fish within the Klickitat drainage (WSCC 1999g).

Fish access problems occur in Rock and Glade Creeks (WRIA 31) due to low or non-existent flows during the late summer, fall, and early winter; barrier road culverts (e.g. Pine Creek); and high stream temperatures in the lower reaches during summer and early fall (WSCC 2000e).

Water quality. In WRIA 29, the mainstem of the White Salmon River has excellent flows and water temperatures year around, due to the fact that the majority of the flow is from glacial melt runoff and/or springs and seeps from the porous basalts that are present throughout much of the watershed. However, two major tributaries (Rattlesnake and Trout Lake Creeks) are impaired by water temperatures that exceed State water quality standards for extended periods of time in the summer (WSCC 2003b). The Wind River and several tributaries, especially Trout Creek, are impaired due to high temperatures (Pelletier 2002) but a TMDL has been completed. High temperatures have also been recorded in the Little White Salmon River and Major Creek, which is impaired due to low instream flow as well.

The Little Klickitat River and Swale Creek in WRIA 30 have been placed on the 303d list and are considered impaired for insufficient flows due to diversions from water supply and irrigation, and for high stream temperatures due to low flows and lack of stream shading (WSCC 1999g, Brock and Stohr 2002). The Little Klickitat River has a TMDL for temperature.

Portions of the entire Columbia River main-stem are included on the 303(d) list and, at times, do not meet water quality standards for total dissolved gases. Most of the river is listed for temperature. Increased water temperatures in the Yakima main-stem (WRIA 37) and many tributaries affect habitat suitability for spawning and rearing, and also increase suitability for species known to prey on juvenile salmonids. Water temperatures are often naturally elevated in this region, but may be further exacerbated by loss of riparian function, altered hydrology, and erosion/fine sediment delivery (e.g. Trout, Crater, Compass, and Layout Creeks within the Wind Basin; Rock Creek (WSCC 2003b); the Yakima Basin). The Yakima River is also impaired by low dissolved oxygen.

High presence levels of toxic substances (e.g., pesticides) have been detected in sediment and fish tissue samples, particularly in mainstem and tributary areas with agricultural return flows (WSCC 2001f). Some resident fish in the Hanford Reach of the Columbia main-stem and the Yakima River have high concentrations of toxic organic chemicals (EPA 2002). The Lower Yakima River has a TMDL for turbidity and DDT (Joy 1997).

In WRIA 38, high temperatures have been recorded in the Naches River and its tributaries, including Cowiche Creek, Tieton River, Rattlesnake Creek, Bumping River and the Little Naches River. The Naches River, Cowiche Creek and Tieton River are also impaired by low in-stream flow.

The Teanaway River has high temperatures and a temperature TMDL (Stohr and Leskie 2000). It is also impaired due to low in-stream flow. Other WRIA 39 waters with high temperatures and low in-stream flows include the Cle Elum River, Manastash Creek, Swauk Creek, Big Creek, and Taneum Creek. Wenas Creek also has low in-stream flows.

Hydropower

Two U.S. Bureau of Reclamation storage dams limit access to many miles of high quality habitat. Specifically, and most significantly, one of the dams has rendered the Tieton River all but unsuitable. Dam operations have radically altered the hydrology of the river, disrupted sediment transport, and created a heavily armored, highly simplified river environment within the Tieton River. The primary limiting factors are habitat access, altered flow regime, loss of floodplain function, and profound habitat simplification in portions of the watershed.

Hydrographic patterns have been substantially altered by the U.S. Bureau of Reclamation reservoir operations, and these reservoirs have blocked many miles of historical habitat in the Upper main-stem of the Yakima River. Operations of one of the dams (Roza dam) may have prevented steelhead migration into the upper Yakima in some years. Diversions and diversion structures prevent access to most of the watershed's tributaries. As a result, steelhead are largely forced to rear in the non-normative flow of the mainstem. The primary limiting factors are the non-normative flow, and lack of access above the storage dams and into most tributaries.

Operations at hydroelectric facilities managed by Chelan and Douglas County PUDs in the mid-Columbia River WRIAs are covered by commitments in HCPs prepared by the PUDs. These habitat conservation plans, referred to collectively as the Mid-Columbia HCP, are for three hydropower projects covering more than 100 river-miles on the main stem of the mid-Columbia River. They are Douglas County Public Utility District's Wells Hydroelectric Project, and Chelan County Public Utility District's Rocky Reach and Rock Island dams.

The public utility districts worked cooperatively with various state and federal fisheries agencies, including National Marine Fisheries Service Service, U.S. Fish and Wildlife Service, Washington Department of Fish and Wildlife, three Native American tribes and an environmental organization, American Rivers, to develop the first hydropower habitat conservation plans for salmon and steelhead.

The plans commit the two utilities to a 50-year program to ensure that their projects have no net impact on mid-Columbia salmon and steelhead runs. This will be accomplished through a combination of fish bypass systems, spill at the hydro projects, off-site hatchery programs and evaluations, and habitat restoration work in mid-Columbia tributary streams.

Hatcheries

There are seven hatchery steelhead programs considered to be part of the Middle Columbia River steelhead DPS. These programs propagate *steelhead* in three of the 16 ESU populations. There are no artificial programs producing the winter-run life history in the Klickitat River and Fifteenmile Creek populations. All of the ESU hatchery programs are designed to produce fish for harvest, although two are also implemented to augment the natural spawning populations in the basins where the fish are released.

NMFS assessment of the effects of artificial propagation on the ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total. Hatchery programs may provide a slight benefit to ESU abundance, principally in the Umatilla and Deschutes Rivers in Oregon. The hatchery contribution to the productivity of the ESU is uncertain, and the contribution to spatial structure is negligible (NMFS 2004, 2004a, 2004b).

Summary of Factors Affecting Covered Species in these WRIAs (by system)

Primary limiting factors for fish, wildlife and associated habitats in the Main-stem Columbia River are generally a result of: (1) hydropower system development and operation, (2) other human activities such as farming, grazing, urban and suburban development, transportation, and industrial or nuclear development, and (3) introduction and proliferation of exotic species. These factors are often interrelated and hard to separate (Mainstem Columbia River Subbasin Summary Draft 2001).

Within the Yakima Basin, many land and water use actions have impacted salmonid habitat conditions and productivity. However, decline in salmon and steelhead in the Yakima Basin is likely associated with irrigation development and diversions, irrigation storage reservoirs and dams, splash damming, mining, removal of beaver dams, and grazing that occurred in the late 1800s and early 1900s. Irrigation was the largest of these impacts. Other habitat impacts began in the later 1900s associated with transportation (rail and roads), urbanization, agriculture, and logging (WSCC 2001d).

Hydroelectric development on the White Salmon River, construction of Bonneville Dam with its associated pool, logging, poorly designed and installed culverts, especially along State Highway 14 have been detrimental to aquatic resources within WRIA 29. The Wind River is the major fish-producing stream system remaining within the WRIA, and its productivity has steadily declined over the years. Major factors within the Wind River system have included stream cleanouts, past timber harvest, a dam without functional fish passage, lack of LWD, mass bedload movement, loss of floodplain capacity, and increased siltation (WSCC 2003b).

Within the Klickitat drainage (WRIA 30), sedimentation, turbidity, and low flows from irrigation and water supply diversions are viewed as significant factors limiting habitat productivity (WSCC 1999g). Also, on the plateau reaches where agricultural and urban land uses occur, the riparian forests have mostly been harvested, or are in a condition where only minimal ecological functions can be provided (WSCC 1999g).

The Yakima drainage (WRIAs 37, 38, and 39) has been significantly impacted by agricultural diversions, storage facilities, and floodplain revetments. This has lead to numerous limiting factors such as habitat access, altered flow regime, loss of floodplain function, and profound habitat simplification in portions of the watershed.

Mid-Columbia River steelhead is comprised of six major grouping, many of which are found in Washington State. The following summarizes the response of those major groupings to the current environmental baseline conditions.

Walla Walla and Touchet. Patches of highly functional habitat remain in both systems, namely the South Fork Walla Walla, Upper North Fork Walla Walla, upper Mill Creek, and portions of the upper forks of the Touchet. However, habitat throughout most of these subbasins has been substantially altered. Irrigation withdrawals severely limit the amount of suitable habitat for spawning and rearing. Many miles of mainstem and tributary (e.g., Mill Creek) stream channel have been diked and channelized impacting rearing and migration. Riparian habitats have been largely removed throughout the agricultural portion of the basin specificallyaffecting feeding and holding while rearing. The mainstem Touchet has been straightened and has deeply incised as result. Poor farming practices deliver a substantial sediment load and pesticides to both rivers and many of their tributaries. The COE facilities pose substantial passage problems in the Mill Creek system and at Nursery Bridge Dam on the Walla Walla mainstem. This directly affects migration.

Yakima River Upper Mainstem. Run-off patterns in the Upper Yakima River have been substantially altered by Bureau of Reclamation (BOR) reservoir operations, and these reservoirs (particularly Cle Elum) have blocked many miles of historical habitat, impeding spawning of MCR steelhead. Operations at Roza Dam, near the downstream terminus of the population boundary, complicated, and in some years may have prevented MCR steelhead migration into the upper Yakima. Diversions and diversion structures prevent access to most of the basin's tributaries. As a result, MCR steelhead are largely forced to rear in the unnatural hydrograph of the mainstem. In addition, a substantial portion of the upper mainstem is isolated from its floodplain by a host of floodplain revetments. Habitat conditions in accessible tributaries generally range in quality from poor to good. A number of the inaccessible tributaries contain good to excellent habitat. However, without access, reproduction capacity is significantly affected.

Naches River. Portions of the lower Naches floodplain are still intact, and many of the tributaries within the national forest, while somewhat degraded by forest management, grazing, and recreational activities, are still functional. Portions of the watershed are nearly pristine. However, irrigation diversions, inadequate fish passage facilities, and floodplain revetments limit habitat quality throughout much of the watershed, detrimentally affecting the ability of MCR steelhead to migrate, spawn, and rear. Two BOR storage dams limit access to many miles of high quality habitat limiting reproduction capacity. Perhaps most significantly, the BOR's operation of Tieton Dam has rendered the Tieton River all but unsuitable. Their operations have radically altered the hydrology of the river, disrupted sediment transport, and created a heavily armored, highly simplified river environment within the Tieton directly impacting the ability of the species to reproduce.

Toppenish and Satus Creeks. Upper Toppenish Creek contains some of the best functioning habitat in the Yakima Basin. Within the limits of anadromy, all of the Satus Watershed is roaded, but habitat within the forest is still fairly functional. Within the shrub steppe zones of both basins, habitat conditions are fair to poor. Much of the Satus watershed was seriously overgrazed, but conditions and range management have improved markedly over the last decade or so. Many of the forest roads in the watershed were poorly located, dirt roads that encroached on stream channels and contributed large amounts of sediment affecting gravel beds and limiting spawning potential. Many of these problem roads have been abandoned and others have been surfaced with rock, reducing sedimentation. The lower 40 miles of Toppenish Creek are severely affected by irrigation water withdrawals and poor water quality resulting from irrigation return flows. Water quality conditions can affect all life history stages. Conditions in both watersheds are improving as a result of Yakama Nation and Bonneville Power Administration (BPA) efforts. Grazing is now largely under control in Satus Creek, and much of the Toppenish Creek floodplain has been reclaimed and planted to native vegetation. This will afford enhanced spawning and rearing capacity.

White Salmon River. Since the completion of Condit Dam in 1913, MCR steelhead have been limited to the lower 3.4 miles of the White Salmon River limiting reproductive capacity. While it is unclear how far up the river MCR steelhead once migrated up the river, most biologists familiar with the area agree that a fall at approximately river mile 16 would be the upper terminus of anadromy if fish were able to pass the dam. The river below the dam is moderately confined within an uninhabited canyon. Habitat conditions there are very good. The White Salmon subbasin has experienced many of the same post-settlement perturbations as other watersheds in the Northwest. Timber harvest, grazing, and agricultural practices each contributed to reduced habitat quality affecting all life history stages. Significant habitat alteration above the dam included draining of vast wetland habitats in the Rattlesnake Creek Valley, heavy grazing of the Trout Lake and early logging practices. At present, habitat conditions above the dam are generally improving as a result improved stewardship. There are problems with water withdrawals and inadequate screens in the Buck Creek watershed, but flows are generally sufficient throughout the lower 16 miles of the White Salmon. Riparian conditions along the mainstem are generally very good. If this watershed was historically critical for MCR steelhead productivity, diversity and abundance, it could provide important space and conditions for species survival.

Klickitat River. Much of the Klickitat on the Yakama Reservation is largely unaltered from historical conditions. The Yakama Nation requires very large forest buffers on the mainstem and tributaries on the reservation. Irrigation withdrawals affect the Little Klickitat River, but the mainstem and other significant tributaries retain more or less natural flow regimes. Grazing has reduced wetland function in the upper Klickitat and some tributaries. The watershed, however, retains a well distributed network of functioning habitats.

The primary limiting factors are a lack of access to the mainstem habitats above Castille Falls, low base flows, habitat simplification, and sedimentation in the Little Klickitat and other tributaries, and channel confinement associated with roads.

2.1.3.4.7 <u>Upper Columbia River Watershed Resource Inventory Areas</u>. WRIAs 40, 44, 45, 46, 47, 48, 49, and 50 include the Wenatchee River, Entiat River, Methow River, Okanogan River, and Lake Chelan with its tributaries. Portions of Kittitas, Chelan, Douglas, and Okanogan Counties are contained within these WRIAs. Lands covered by the Forest Practices HCP in these WRIAs lie within the Northern Cascades and Okanogan Highlands physiographic provinces (Lasmanis 1991). Elevations range from approximately 500 feet along the Columbia River to over 8,000 feet along the Cascade crest. The effects of past and present actions in this area are relevant to the freshwater biological requirements of all ESUs of Upper Columbia salmonids, including listed steelhead and spring-run Chinook. These WRIAs are unlikely to contain the biological requirements of unlisted non-salmonids covered in this consultation.

Since, 1999, NMFS completed about 58 formal consultations covering actions proposed in these WRIAs. Thirty four of those were conducted with the COE for permits covering individual and joint use residential docks and piers, including a programmatic consultation for the issuance of a Regional General Permit covering those projects meeting certain specifications. NMFS consulted with different action agencies on 10 separate fish passage, screening, or habitat restoration projects addressing existing burdens on fish passage in these WRIAs. NMFS consulted with the FHWA (among others) on five bridge or road maintenance or repair projects. NMFS also conducted four bank stabilization or bulkhead construction projects and four consultations on United States Forest Service special use permits or other similar projects related to water diversions and ditches.

The following is a brief description of conditions resulting from myriad historic non-Federal actions and the Federal actions summarized above.

Hydrology

Heavy snowfall accumulation along the North Cascades mountain axis serves as the water storage for summer flows. Channels draining lower foothills lack the storage, and are more prone to seasonal drying. Summers are typically very dry, especially at lower elevations. In dry years with reduced snowpacks, instream flows become severely reduced, resulting in dewatered reaches and substantially higher summertime water temperatures (WSCC 2000f).

In the Methow River headwaters, annual precipitation ranges from over 80 inches along the Cascade Crest to approximately 10 inches near the town of Pateros. Approximately two-thirds of the precipitation occurs between October and March, mostly in the form of snow. Summers are generally hot and dry with infrequent precipitation coming from brief and intense thunderstorms. In fall, precipitation increases and generally peaks in the winter between December and February in the form of snowfall (WSCC 2000f).

In the Methow watershed, seasonal hydrology is dominated by snowmelt, with peak flows occurring during spring and early summer. Rainfall driven peak flows may occur in November and December. From September to March, stream flow is sustained by groundwater, autumn precipitation, and limited snowmelt (WSCC 2000f).

Major forested watersheds in these WRIAs include the Wenatchee, Entiat, Methow, and Okanogan rivers. These rivers, including Lake Chelan, are all tributary to the Columbia River. The rivers have a snowmelt-driven hydrologic regime where most peak flows occur from April through June in response to spring snowmelt. However, large magnitude peak flows result from rain-on-snow precipitation events that occur during the fall and winter months. Low flows generally occur during late summer and early fall, although extreme cold can substantially reduce flows during the winter. Based on the DNR stream hydrography GIS coverage, there are approximately 23,240 stream-miles (both fish-bearing and non-fish streams) in these WRIAs, with an average stream density of 2.32 stream miles per square mile.

Habitat

Land cover and use. Forestland makes up approximately 43 percent of this analysis region and shrubland and grassland together also comprise about 43 percent. Agricultural lands make up nine percent and the remaining four percent consist of water/wetlands and ice, snow, and bare rock. The percent forestland within each WRIA varies considerably, ranging from a low of one percent in the Moses Coulee WRIA to a high of 74 percent in the Wenatchee WRIA. An analysis for road density in the region yielded an average road density of three miles per square mile (WDNR 2004).

Forest ownership and management. Approximately 51 percent of all forest lands in these WRIAs are in Federal ownership and a portion of these lands (about 19 percent of all lands) are being managed for long-term preservation, primarily in national parks, wildernesses, and national wildlife refuges. Another large portion of these Federal lands is being managed by the Forest Service outside of wilderness (25 percent of all lands). A substantial portion of these non-wilderness National Forest System lands is being managed under a very limited management status (e.g., LSRs, Managed LSAs, AMAs, or Riparian Reserves) according to the Northwest Forest Plan. The remainder of the Federal lands (seven percent of all lands) is being managed by other agencies. Tribal lands represent seven percent of this land area. State lands represent 12 percent of all lands in the region, private lands represent 31 percent, and city/county lands represent much less than one percent.

The WRIAs differ markedly in their ownership. The Wenatchee, Entiat, Chelan, and Methow WRIAs are dominated by Federal lands (80 to 86 percent) in the Wenatchee and Okanogan National Forests. In contrast, the Foster and Moses Coulee WRIAs contain only two and six percent Federal lands, respectively.

Approximately 78 percent of the forestlands in this analysis region are in Federal ownership, four percent are in Tribal ownership, nine percent are in State ownership, and nine percent are in private or other ownership. Approximately 37 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately eight percent of the forestlands and nine percent of the forestlands are in private, county, city, or tribal ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 17 percent of the forestlands in the region. Existing riparian HCPs cover none of the State-managed lands (although an HCP relating to some wildlife covers 12 percent of the State lands in the region) and only about 0.1 percent of the combined private, county, and city ownerships.

The Okanogan WRIA accounts for more than half of the forestlands under the State forest practices rules in this region. This WRIA contains the largest acreage of both State and privately managed lands (167,535 acres of State lands and 107,596 acres of private, city/county lands). The Wenatchee WRIA is another with a high acreage (86,090 acres) of privately managed forestlands. All other WRIAs have less than 35,000 acres of combined State and privately managed forestlands.

Small, 20-acre eligible forest landowners make up about 0.3 percent of the forestlands and about 1.5 percent of the forestlands subject to forest practices rules in this analysis region, based on the analysis by Rogers (2003). The highest percentage (about one percent of the forestland) is in the Moses Coulee WRIA and the lowest percentage (less than 0.1 percent) is in the Methow WRIA.

Approximately 3,130 stream miles occur on lands subject to forest practices rules in this region (13 percent of all streams in the region). Approximately 2,629 miles or 84 percent of the 3,130 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre eligible forest landowner parcels in this region is estimated to about 0.6 percent and the percentage of all fish-bearing streams on small, 20-acre eligible forest landowner parcels is about 0.8 percent (Rogers 2003).

Sediment/mass wasting. Chronic and catastrophic sediment delivery to streams (correlated with highly erodible soils, exacerbated by high road densities, road placements, and grazing) and reduced levels of LWD (from stream cleanouts and loss of riparian recruitment material) are driving habitat degradation in the lower half of the Chewuch River, Libby Creek, Gold Creek, and Boulder Creek drainages (WSCC 2000f).

Sediment delivery from high road densities on Forest Service lands is one of the most important impacts driving habitat degradation in Chumstick Creek, which is considered one of the most problematic drainages in the entire Wenatchee basin relative to land use impacts and management issues. The second most important habitat limiting factor in the basin comes from road location and density in the Little Wenatchee River drainage, with emphasis on the lower reaches of the mainstem and Rainy Creek (WSCC 2001f). High road densities have also been identified in the Entiat River and Methow River basins as contributing towards habitat degradation.

Sedimentation of the Okanogan mainstem and tributary systems is primarily attributed to roads, logging, agricultural practices, and hydrological manipulations. Roads are likely the greatest contributing source of sediment to streams in the Okanogan watershed. Road densities in most Okanogan sub-watersheds exceed four miles per square mile (Okanogan/ Similkameen Subbasin Summary 2002). According to Cederholm et al. (1981), sediment delivery to streams is considered to be greater than natural erosion rates when road densities exceed four miles per square mile. Within the Omak subwatershed, bank erosion from heavy livestock grazing, and high road densities have been identified as significant sources of sediment (Okanogan/Similkameen Subbasin Summary 2002).

Riparian/floodplain and wetland conditions. Within the Columbia River basin, most of the mainstem habitat has been reduced to a single channel, floodplains have been reduced in size, and off-channel habitat features have been lost or disconnected from the main channel (Mainstem/Systemwide Habitat Summary 2002). Floodplain connectivity, side channel habitat, and riparian function is especially limiting within the Entiat and Methow watersheds (e.g. Entiat mainstem, Mad River, Stormy Creek, Stillwaters Reach, and Roaring Creek (WSCC 1999h)).

The alluvial fans of every major tributary to the Methow River, from the Lost River to the town of Winthrop, have been diked and channelized to some extent (Lost River, Early Winters Creek, Goat Creek, Wolf Creek, Chewuch tributaries, Twisp River). Accelerated bank destabilization is occurring where riparian lands have been converted to residential and agricultural use (WSCC 2000f).

Floodplain habitat along the Wenatchee River corridor must provide accessible, high quality off-channel habitat to meet the spawning, rearing, and migratory habitat needs of all life history stages of spring and summer Chinook salmon, steelhead trout, and sockeye salmon. Floodplain function and riparian habitat in the lower reaches of the Nason Creek, Icicle Creek, Mission Creek, and Peshastin Creek watersheds is not properly functioning. Loss of floodplain and off channel habitat is also the greatest threat to salmonid production in the White/Little Wenatchee Watershed, which has among the best aquatic habitat and strongest native fish populations within the Columbia basin (USFS 1998; WSCC 2001f).

Within the Okanogan River, floodplain connectivity is limited due to the presence of Highway 97. The river is also slightly entrenched and the control of the water level does not allow the channel to overflow its banks into the floodplain (Okanogan/Similkameen Subbasin Summary 2002).

Channel/hydrology conditions. Within the Columbia River mainstem, the natural hydrograph has been altered by dams, decreasing spring and summer flows, and increasing fall and winter flows. This alteration has affected most associated channel conditions such as floodplains, off-channel habitat, LWD, and water velocities (Mainstem/Systemwide Habitat Summary 2002).

As part of the Limiting Factors Analyses (WSCC 1999h), the transport zone of the upper Entiat system has been rated to have good to excellent habitat quality with habitat diversity provided by side channels, boulders and LWD. Within the Transitional Zone (mid-Entiat), the aquatic habitat has been modified from historic conditions, with 30 to 60 percent loss of pools in the mainstem and a contrasting recovery of pool habitat in the Mad River. Some channel reaches have been locally impacted by timber harvest in tributaries and at road crossings. However, the habitat is rated fair to excellent in the transitional zone and is primarily used by bull trout and other resident fishes. The lower depositional zone of the Entiat is the principal spawning/rearing habitat for anadromous fish. This zone has poor to fair habitat quality with low levels of LWD, a 90 percent reduction of pools, and high levels of fine sediment, largely the result of past flood control efforts (WSCC 1999h). Within the mainstem Okanogan, high levels of fine sediments, silt, and mud has lowered in-channel habitat quality (Okanogan/Similkameen Subbasin Summary 2002).

Large woody debris. The amount of LWD (large snags and log structures) has been reduced in the Columbia River mainstem (Mainstem/Systemwide Habitat Summary 2002). LWD levels are inadequate throughout the upper and middle Methow River watersheds, although LWD has been improving and reaching "adequate" levels from the headwaters to Goat Creek. Removal of large riparian trees along the lower 25 miles of the Chewuch River, the lower reaches of Lake Creek, and the lower 15 miles of the Twisp River have reduced LWD levels (WSCC 2000f). LWD is virtually nonexistent in the Okanogan mainstem (Okanogan/Similkameen Subbasin Summary 2002). Past timber harvest within riparian areas on the mainstem Little Wenatchee and Rainy Creek has reduced potential for LWD recruitment, altered runoff and water storage patterns, and increased fine sediment input into receiving waters (WSCC 2001f).

Fish passage and barriers. Within the Columbia River mainstem, hydropower operations have resulted in either complete or partial fish passage barriers both up and downstream. Power operations have also affected fish movement through reservoirs by stranding fish in shallow areas and cutting off important spawning areas in tributary streams during drawdowns (Mainstem/Systemwide Habitat Summary 2002).

Unscreened, inadequately screened, and improperly designed surface water diversions (pumps and ditches) and dams pose a direct threat to salmonids in the Entiat watershed (WSCC 1999h). Numerous man-made fish passage barriers and unscreened water diversions have been identified in the Beaver Creek drainage (Methow watershed) (WSCC 2000f). While Icicle Creek (Wenatchee watershed) is a highly functional watershed, fish passage barriers, as well as barriers resulting from low flows, and high stream temperatures create habitat limitations (WSCC 2001f).

The Okanogan River and most tributaries have man-made barriers, including dams, culverts, and dewatered stream channels. Twenty-one dams exist within the United States' portion of the Okanogan watershed. The Similkameen River is impassable to all anadromous salmonids at Enloe Dam, with 95 percent of the potential fish habitat upstream of the blockage. Diversions in Loup Loup, Salmon Creek and Antoine Creek prevent full use of the habitat potentially available in those systems (Okanogan/Similkameen Subbasin Summary 2002).

Water quality. Portions of the Columbia River mainstem do not meet water quality standards for total dissolved gases or temperature (EPA Columbia and Snake River mainstem TMDL homepage). The lower reach of the Entiat River (WRIA 46) is considered impaired due to high temperature and low instream flow. The Mad River also has high stream temperatures, but reports have shown that these temperature exceedances have mostly resulted from natural geology and hydrology of the system (USFS 1999, WSCC 1999h).

Portions of the mainstem Methow River (WRIA 48), from Robinson Creek downstream to the Weeman Bridge, naturally dewater during drought years. Low flows also occur in the lower eight miles of the Chewuch River, the lower four miles of the Twisp River, the lower Wolf Creek, and the lower portions of Libby and Gold creeks (WSCC 2000f). The Methow and Twisp Rivers also have elevated water temperatures. High water temperatures in lower and middle Goat Creek could be attributed to the aspect of the drainage, the lack of seeps and springs in the confined channel, and the removal of vegetative cover in Goat Creek and its tributaries (USFS 2000).

Within some areas of the Wenatchee basin (WRIA 45), low instream flows and dewatering naturally occur due to climatic and geologic conditions. However, water diversions and withdrawals also contribute to low flows and high stream temperatures in the lower Wenatchee River, lower Icicle Creek, Peshastin Creek and Mission Creek. Stream temperature is also a limiting factor in the lower Chiwawa River (WSCC 2001f). Low dissolved oxygen has been recorded in some WRIA 45 waters including the Wenatchee River and Icicle Creek (WDOE 1998, 2004).

In WRIA 49, portions of the Okanogan River are impaired due to high temperatures and low dissolved oxygen. The Similkameen River at times fails to meet water quality standards for temperature and arsenic, and Salmon Creek is impaired due to low instream flow. Stream flow in the Okanogan River, as well as most of the tributaries, has been altered for flood control, irrigation, and recreation activities. As a result, the natural hydrograph has been severely altered and is likely a key limiting factor in this system (Okanogan/Similkameen Subbasin Summary 2002).

Summary of Factors Affecting Covered Species in these WRIAs

The predominant limiting factor for the Columbia mainstem has generally been the result of the development and operation of hydropower and storage dams. Other human activities associated with farming, irrigation, grazing, urban and suburban development and transportation have also contributed to habitat degradation. Exotic species have competed and often displaced native species (Mainstem Columbia River Subbasin Summary Draft 2001, Mainstem/Systemwide Habitat Summary 2002).

Habitat limiting factors occur naturally in these WRIAs. Natural limiting factors include extreme winter conditions, summertime high water temperatures, reduced stream flows, and natural disturbances such as fire, flood, and landslides. However, various land management practices have exacerbated the influence of these limiting factors by further altering natural processes. These human-induced alterations have occurred primarily in lower gradient, lower elevation reaches of watersheds and include road building and placement, conversion of riparian habitat to agriculture and residential development, water diversions, reduced LWD recruitment, and flood control efforts (WSCC 2000f, 2001f). In Cub, Boulder, Eightmile and Falls creeks (all in the Chewuch River subwatershed), and in the Goat, Beaver, Libby and Gold creek drainages, impacts also extend into the upper reaches of the drainages. These impacts are mostly the result of past timber harvest operations, road building and placement, and grazing (WSCC 2000f). Overall, habitat quality is rated higher within the upper reaches of the watersheds (e.g., Methow, Wenatchee, and Entiat) (WSCC 2000f, 2001f).

A lack of juvenile over-wintering habitat appears to be the most limiting condition to sustaining salmon populations in the Entiat watershed. This pattern is a function of the alteration of the natural hydrologic and geomorphic processes in the watershed resulting from losses in floodplain connectivity and riparian zone conditions (USDA NRCS 1998; USFS 1996; WSCC 1999h).

Within the Okanogan basin, barriers to fish migration, elevated temperatures, and sedimentation are among the primary limiting factors to anadromous fish reproductive success. Unnaturally warmer waters, low velocities and heavy sedimentation in the mainstem favor exotic species, which can compete with native stocks (Okanogan/ Similkameen Subbasin Summary 2002).

The UCR steelhead endangered listing has been upgraded to "threatened." The DPS remains listed because of a number of factors. Among them are dams, recreational and incidental commercial fishing, habitat modification, hatchery influences, and non-point source pollution. In addition to the lower Columbia River mainstem dams, the construction of Grand Coulee Dam blocked over 1,100 miles of river access by anadromous fish. The details of the remaining survival threats are essentially the same as those described above for LCR steelhead, with the exception that UCR steelhead spawning and juvenile rearing habitat are more susceptible to the effects of drought.

The listing of UCR spring-run Chinook as threatened was attributed to a number of factors. Among them were hydropower development, degraded riparian and instream habitat, and influences of hatchery fish. Hydropower development on the Columbia River has adversely affected migrations and flow regimes. Degraded riparian and instream habitat resulted primarily from urbanization and livestock grazing. Artificial propagation efforts have had a significant impact on spring-run populations, either through hatchery-based enhancement or extensive mixing of stocks through hatchery releases. Migrating juvenile UCR spring-run Chinook are also subjected to the same predation issues by Northern Pikeminnow at mainstem hydropower dams discussed under Snake River spring and fall-run fish.

Within the Wenatchee subbasin, important spawning areas in the White, Little Wenatchee, and Chiwawa Rivers remain in mostly healthy, properly functioning condition. Another important spawning area, Nason Creek has been significantly affected by highway and railroad construction which severed a substantial amount of side channel habitat and truncated the floodplain. Other significant but lesser tributaries (Peshastin, Chumstick, and Mission Creeks) have been substantially altered by road construction, residential development and water withdrawals such that Peshastin Creek is now the only one of the three that still supports any Spring-run Chinook spawning, and that only in better water years. Highway and railroad construction, and to a lesser extent, residential development have also substantially reduced floodplain connectivity, side channel habitat, and riparian quality along much of the mainstem Wenatchee River. While the most important spawning areas are the previously listed tributaries, the mainstem Wenatchee is an important rearing and overwintering area. The lower mainstem Wenatchee is substantially affected by irrigation withdrawals in the late summer and early fall, particularly in drier years. The barrier at the Leavenworth National Fish Hatchery blocks access to nearly a few miles of fair habitat. Partially natural, partially anthropogenic falls about three miles above the hatchery prevents access to about 17 miles of potentially highly productive habitat. Riparian conditions in the major tributaries, except in Nason Creek, are generally excellent. The mainstem Wenatchee downstream from Leavenworth is largely devoid of structural wood.

The most significant factors limiting the productivity of Spring-run Chinook in the Wenatchee River are: (1) the seven downstream hydroelectric Dams on the Columbia River, (2) loss of access to the upper Icicle River, (3) loss of off-channel habitat in mainstem and Nason Creek (which adversely affect late summer rearing and overwintering conditions), and (4) the habitat alterations in other significant tributaries like Peshastin, Mission, and Chumstick Creeks. Late season flows in the lower Wenatchee mainstem, and the lack of large, in-channel wood are also significant problems.

Upper Columbia River Spring-run Chinook presently spawn in portions of the mainstem Entiat, and the Mad River. The channelization of the lower 14 miles of the Entiat River dramatically reduced spawning habitat quantity and quality. This channelization, and associated loss of off-channel habitats and riparian function, is the most significant habitat alteration in the watershed. The Entiat is less severely affected by water withdrawals than the other subbasins occupied by the ESU. Most of the withdrawals are downstream of the spawning areas, but they do limit habitat quality and quantity particularly in drier years. All known irrigation diversions in the subbasin are screened to modern standards (Egbers, pers. comm., 2005). Sedimentation from forest lands is a significant factor. The steep terrain, highly erodible soils, forest road locations, and fire frequency combine to make sedimentation a significant problem in the Entiat. The Entiat Valley is also growing in popularity as a retirement and vacation getaway for people from urban areas. Some of the most desirable building locations are along the productive floodplain reaches

The primary factors limiting the productivity of Spring-run Chinook in the Entiat are the eight downstream hydroelectric dams on the Columbia River, the effects of channelization (loss of habitat quantity and quality, in particular the loss of channel sinuosity and off-channel habitat, and LWD), sedimentation, and low base flows.

The Methow River still supports of number of pristine to nearly pristine habitats, mostly within designated wilderness areas. A number of important production areas, however, have been and continue to be adversely affected by human activity. Irrigation water withdrawals substantially reduce habitat quality and quantity during base flow periods in the mainstem Methow, lower Chewuck, and lower Twisp Rivers. A number of lesser tributaries are completely dried by irrigation withdrawals. Some of the diversions on the mainstem and large tributaries are accomplished with gravel “push-up” dams that can impede passage during low flows and create locally unstable habitat conditions. Furthermore, maintaining these structures, which is accomplished by dozing additional alluvium from the riverbed can destroy redds. Most of the irrigation withdrawals are screened to modern standards. Several reaches of the mainstem and tributaries are listed under Section 303(d) of the Clean Water Act as impaired for various parameters including temperature and instream flow. Most stream reaches downstream of wilderness areas lack sufficient instream flow. Large wood has historically been removed from stream channels following larger floods. Revetments have further limited channel complexity and off-channel habitat in the lower Lost, Chewuck, and Twisp Rivers, and at various locations on the mainstem. Riparian conditions have also been adversely affected as a result of agricultural, silvicultural, residential, and recreational activities.

The most significant factors limiting the productivity of Methow Spring-run Chinook are the nine downstream dams on the Columbia River, irrigation-related substantial reductions to base flow, particularly in drier years; loss of off-channel habitats, lack of large wood; and loss of riparian vegetation. Sedimentation is also a problem in the lower Chewuck.

***2.1.3.4.8 Snake River Watershed Resource Inventory Areas*.** WRIAs 32, 33, 34, and 35 include the Walla Walla, Lower Snake, Tucannon, Grande Ronde, Palouse, and Middle Snake River basins. Portions of Walla Walla, Columbia, Garfield, Whitman, and Asotin Counties are contained within the Snake River Region. The region encompasses the Blue Mountains physiographic province and part of the Columbia Basin province (Lasmanis 1991). The effects of past and present actions in these WRIAs are relevant to the biological requirements of four listed ESUs of salmonids including Snake River sockeye, *O. mykiss*, spring-run Chinook, and summer/fall-run Chinook.

Since 1999, NMFS completed 24 formal interagency consultations in the Snake River WRIAs. Of those, 11 were with the U.S. Department of Transportation covering 10 bridge replacements and the realignment of SR12 from SR124 to Wallula Junction in Walla Walla County. Six formal consultations with the COE covered two levee maintenance, two dredging, and two marina/ boat ramp actions. Four consultations with BPA covered two fish screen replacements, one habitat restoration, and one bridge reconstruction project. Finally, two consultations with the U.S. Fish and Wildlife Service covered two habitat restoration projects.

None of the subject consultations concluded with a jeopardy or adverse modification of critical habitat determination. For actions such as each of the bridge replacements, preexisting structures that limited function and utility of habitat were removed and replacement with structure designed to avoid those effects. For example, bridge abutments within the stream margin affecting nearshore migration and feeding for juveniles were removed in favor of bridges spanning the ordinary high water for the particular action area. Similarly, screen replacement and habitat restoration projects were designed to improve habitat function and utility, and prevent impingement of habitat modification-based injury or death of salmonids.

In contrast, construction of projects to increase water-based recreation such as boat docks and ramps, as well as the dredging projects modified existing, albeit low-functioning habitat. These actions typically included minimized footprints and some element of habitat restoration to offset effects. Furthermore, construction was proscribed by inwater work windows and best management practices to minimize the exposure of salmonids to transient project effects like increased turbidity.

The following is a description of existing conditions in these WRIAS and the responses of the regional ESUs to the historic actions in this region.

Hydrology

Major rivers of the region include the Walla Walla, Tucannon, Grande Ronde, and Palouse, all of which are tributary to the Snake River. The rivers have a snowmelt-driven hydrologic regime; most peak flows occur from March through May in response to spring snowmelt. However, large magnitude peak flows result from rain-on-snow precipitation events that occur during the fall and winter months. Low flows generally occur during late summer and early fall, although extreme cold can substantially reduce flows during the winter. Based on the DNR stream hydrography GIS coverage, there are approximately 8,343 stream-miles (both fish-bearing and non-fish streams) in the Snake River region, with an average stream density of 1.17 stream miles per square mile.

Habitat

Land cover and use. Forestland makes up approximately eight percent of the Snake River region, ranging from none in the Lower Snake WRIA to 16 percent in the Middle Snake WRIA. Agricultural lands comprise 52 percent of the region and are particularly prevalent in the Walla Walla and Palouse WRIAs. Shrublands and grasslands also comprise a substantial portion of the region representing 29 percent and eight percent, respectively. An analysis for road density in the region yielded an average road density of 2.5 miles per square mile (WDNR 2004).

Forest ownership and management. Approximately 10 percent of all lands in the Snake River region are in Federal ownership and three percent of all lands are being managed in a Federal long-term preservation status, primarily in national parks, national wildlife refuges, and wildernesses. No Tribal lands exist in the region, but State lands (primarily under management for timber production) comprise six percent and city/county lands represent less than 0.1 percent. Private lands represent 84 percent of the region. They range from 71 percent of the Middle Snake WRIA to 92 percent of the Palouse WRIA. Federal lands follow the reverse pattern ranging from two percent in the Palouse WRIA to 22 percent in the Middle Snake.

Generally, 63 percent of the forestlands in the Snake River region are in Federal ownership, none are in Tribal ownership, five percent are in State ownership, and 32 percent are in private or other ownership. A Federal or State status of preservation or limited management covers approximately 25 percent of the forestlands in the region. About 40 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately three percent of the forestlands, and 32 percent of the forestlands are in private, county, or city ownership, where timber management can occur. Overall, lands covered by the forest practices rules represent approximately 35 percent of the forestlands in the region. The overall percentage of forestlands subject to the State forest practices rules ranges from 13 percent in the Middle Snake WRIA to 81 percent in the Palouse WRIA. No existing HCPs cover the State, private, or other managed forestlands in this basin.

Small, 20-acre eligible forest landowners make up less than 0.5 percent of the total forestlands and of the forestlands subject to forest practices rules in the Snake River, based on the analysis by Rogers (2003).

Approximately 824 stream miles occur on lands subject to forest practices rules in the Snake River region. This represents 10 percent of all streams in the region. Approximately 708 miles or 86 percent of the 824 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre eligible forest landowner parcels in this region is estimated to be less than 0.5 percent (Rogers 2003).

Sediment/mass wasting. Many stream reaches in the Walla Walla basin adjacent to or downstream from private lands carry extremely high fine sediment loads derived from erosion of agricultural fields. This has led to embedded and/or buried streambed substrate, significantly reducing the area available for salmonid spawning habitat (WSCC 2001e).

The U.S. Forest Service reported that more than 50 percent of the sediment delivered into Asotin Creek from timber harvest activities came from existing roads. Some of the forested drainages in the Asotin Creek watershed have road densities as high as 4.1 to 5.0 miles per square mile. Salvage harvest after the 1974 floods have resulted in active erosion, sediment delivery and increased stream temperatures in the North and South Fork Asotin Creeks (USFWS 2002).

Riparian/floodplain and wetland conditions. Hydropower production along the Snake River has reduced the mainstem habitat (for the most part) to a single channel, floodplains have been reduced in size, and off-channel habitat features have been lost or disconnected from the main channel (Mainstem/Systemwide Habitat Summary 2002). Diking, channelization, removing vegetation from riparian zones, and conversion of floodplains into agricultural land and road networks have all contributed towards destruction of fluvial function and off-channel habitat (WSCC 2001e; USFWS 2002).

In streams such as Lick Creek (Asotin basin), riparian zones are in poor condition along some reaches. Clear-cuts were used to harvest timber immediately adjacent to the stream edge, and trees have not reestablished (USFWS 2002). Streams in the upper watershed are generally reported to contain higher quality riparian zones compared to lower reaches where more streamside activities occur (WSCC 2001e).

Channel/hydrology conditions. Many Walla Walla stream reaches adjacent to or downstream from private lands lack instream habitat complexity associated with abundant amounts of LWD, pools, and off-channel habitat. Though channel conditions (such as LWD and pool quantities) are not ideal on public lands in the headwaters, they are far more favorable to salmonids than those found downstream on private lands (WSCC 2001d). Pool habitat in lower Asotin Creek, is limited in part because sources of LWD have been eliminated by timber harvest on private property and because livestock have grazed riparian areas (ACMWP 1995).

Large woody debris. Along with other major channel modifications caused by hydropower (i.e., floodplain and off-channel habitat, fluctuating flows and water velocities), as well as adjacent land uses on the Snake River mainstem, the amount of LWD has been reduced

(Mainstem/Systemwide Habitat Summary 2002).

LWD is lacking in nearly all reaches of the Upper Touchet subbasin. The lack of wood is caused by widespread riparian zone degradation and removal of large wood from channels in flood control efforts. An effect related to low LWD loading is the lack of pool habitat (WSCC 2001e).

Fish passage and barriers. Barriers to fish passage include hundreds of inadequately screened surface water diversions in the Walla Walla basin. Other structures which hinder salmonid migration in the Walla Walla basin include gravel push-up dams, concrete dams, and failed culverts (WSCC 2001e).

Dams within the Tucannon River and Asotin Creek watersheds have had significant historical impacts on salmonids in both streams. Two of these dams are still present and may be affecting bull trout migrations. Many road culverts with variable impacts on fish passage have been identified within the Snake River region. In addition, destruction of riparian zones, leading to high water temperatures, is the most significant factor acting to reduce fish movement and habitat use in the middle to lower reaches of the Tucannon River and Asotin Creek (USFWS 2002).

Water quality. The Snake River (WRIAs 33 and 35), from its confluence with the Salmon River to its confluence with the Columbia River, has been included on the 303(d) list of impaired waters for temperature and total dissolved gases (EPA Columbia and Snake River TMDL homepage). The Snake River has a TMDL for total dissolved gas (Pickett and Herold, 2003).

Within the region (e.g. lower Tucannon River, USFWS 2002), many stream reaches exhibit low or non-existent summer stream flows and water temperatures far above the tolerance level of salmonids. These conditions are a combination of naturally arid summer climatic conditions, surface water withdrawals, removal of riparian vegetation, and disruption of surface water/ground water exchanges (hydraulic continuity) through bank armoring, channel straightening, and diking of floodplains (WSCC 2001e). The Tucannon River (WRIA 35) is impaired by high temperatures and the Walla Walla River and Mill Creek (WRIA 32) are impaired by low instream flow. In WRIA 34, the Palouse River is impaired by high temperatures and low dissolved oxygen.

Between 1970 and 1989, approximately 2,995 hectares of forest were clearcut along tributaries to Asotin Creek in WRIA 35, including Charley Creek, South Fork Asotin Creek, and two 2-hectare harvests on both sides of Cougar Creek. The U.S. Forest Service indicated that these early cuts contributed to rises in water temperatures along adjacent streams because all riparian and upslope timber was harvested. Adequate riparian canopy has not regenerated along Cougar Creek where these two cuts occurred (ACMWP 1995).

Timber harvest in these WRIAs began in earnest in the1880s. Most harvest occurred near streams in lowland riparian zones dominated by deciduous species such as willow, cottonwood, birch, and alder (Saul et al., 2000). Early harvests within the Walla Walla basin focused on the most profitable trees such as large Douglas fir and Ponderosa pine. Harvest then shifted to western larch, grand fir, white fir, and lodgepole pine once Douglas fir and Ponderosa pine supplies were exhausted. Logs were commonly yarded across streams, destroying spawning grounds. Stream channels were also modified. Clearcutting was the logging method of choice, leaving large areas devoid of mature vegetation, increasing the likelihood of erosion and landslides (WSCC 2001e).

Although timber harvest comprises the third largest economic activity in the Tucannon River watershed, most of the timber-related impacts that occur today in the Snake River region are the result of historical timber harvest and road building activities (legacy effects) (USFWS 2002). Agriculture, which comprises 58 percent of the Walla Walla watershed, is the primary component of the economy today (as well as the Asotin and Tucannon River watersheds, USFWS 2002) and has degraded salmonid habitat in many areas of the watershed.

Many of the rivers that are part of the Snake River region such as the Grande Ronde River, Tucannon River, and Asotin Creek are categorized as poorly functioning habitat. Most of the rivers have impaired water quality. Floodplain conversion for agriculture and urbanization has taken place heavily in the region, and the rate of flow diversion is high for many of the rivers.

McClure (2004) classified major rivers and streams within the Snake River region into three categories: (1) highly compromised habitat (four to seven tributary habitat factors identified as impaired), (2) moderately compromised habitat (one to three tributary habitat factors identified as impaired), and (3) minimally compromised habitat (no tributary habitat factors identified as impaired). The Tucannon River was categorized as "highly compromised habitat," and Asotin Creek and Grande Ronde River were categorized as "moderately compromised habitat."

McClure (2004) also ranked major streams within the Snake River region in relation to various habitat factors on a scale of 1 to 10 (1 having the lowest, and 10 the highest probability of being impaired). In terms of chemical toxicity, Tucannon River - South (rated 9), and Asotin Creek (rated 9) had the highest probability for degradation among the region streams followed by Grande Ronde River lower mainstem tributary (rated 7). The Grande Ronde River lower mainstem tributary (rated 7) and Asotin Creek (rated 7) had the highest probability of being impaired for forest generated sediment among the streams in this analysis region.

As stated by McClure (2004), heavy conversion of historical floodplain area to agriculture/urban land use has occurred on Tucannon River (70 to 80 percent) as well as the Upper Grande Ronde River (90 to 100 percent). As far as the rate of flow diversion for irrigation is concerned, the Upper and Lower Grande Ronde River (70 to 80 percent) has seen the most severe withdrawal. In terms of the entrainment potential predicted from the number of diversions encountered, Upper Grande Ronde River (90 to 100 percent) and the Lower Snake/Tucannon (70 to 80 percent) had the highest susceptibility. The Wenaha River population had 304 diversions.

Storage dams and their associated impoundments have eliminated spawning and rearing habitat and have altered the natural hydrograph of the Snake River, decreasing spring and summer flows and increasing fall and winter flows. Snake River dam construction has also converted riverine habitat to more reservoir-like habitat, impacting species composition and increasing predator abundance (USFWS 2002).

The Bull Trout Recovery Plan (for the Snake River Recovery Unit) identifies till crop production and irrigation withdrawals, livestock grazing, logging, hydropower production, introduction and management of nonnative species, urbanization and transportation networks as factors adversely affecting bull trout (USFWS 2002).

Within the Walla Walla basin, land use impacts associated with surface water withdrawals, dryland agriculture, and residential development have had profound impacts on salmonid habitat. Habitat conditions on public lands managed by the USFS (mostly within the headwaters) stand in stark contrast to the degraded conditions found on private lands downstream. Headwaters throughout the Blue Mountains provide the last remaining area of refuge for spawning and rearing summer *O. mykiss* and bull trout (WSCC 2001e).

2.1.3.4.9 Southwest Washington Watershed Resource Inventory Areas**.** WRIAs 22, 23, and 24 include the Naselle, Elochoman, Hoquiam, Satsop, Chehalis, North and Willapa River Basins, as well as other smaller tributaries. Portions of Grays Harbor, Thurston, Pacific, Lewis, and Cowlitz Counties are contained within these WRIAs. The region includes portions of four physiographic provinces: the Olympic Mountains, the Willapa Hills, the Puget Lowland, and the Southern Cascades (Lasmanis 1991). Elevations range from sea level to approximately 3,500 feet. The effects of past and present actions in these WRIAs are particularly relevant to several listed and unlisted ESUs of salmonids including threatened Lower Columbia River Chinook salmon, Columbia River chum salmon, Lower Columbia River *O. mykiss*, and the proposed Lower Columbia River coho salmon.

Presently, there are no ESA-listed species in southwest Washington WRIAs. Therefore, NMFS has not conducted any ESA interagency consultation in this analysis region. However, since 2001, NMFS completed 12 Essential Fish Habitat consultations for projects likely to adversely effect essential fish habitat designated under the Magnusson-Stevens Fishery Conservation and Management Act (MSA, 16 U.S.C. 1801, et seq). Several of these consultations included conservation recommendations to minimize the identified effects. One consultation did not make conservation recommendations because the project included measures adequate to avoid, minimize, or otherwise offset adverse effects to designated EFH. The MSA identifies a written response requirement for action agencies declining to implement conservation recommendations. NMFS has a record of one refusal to conduct the conservation recommendations and that was for an earlier consultation on the project mentioned above that now includes conservation measures as part of the proposed action.

Hydrology

The Chehalis River drains much of southwest Washington and flows into Grays Harbor at the town of Aberdeen. These WRIAs also contain several smaller river basins including the Humptulips, North, Willapa, and Naselle. The Humptulips River is tributary to Grays Harbor while the others flow into Willapa Bay. Because these rivers drain relatively low elevation watersheds, peak flows result almost exclusively from high-magnitude rainfall events that occur during fall and winter. Low flows occur in late summer or early fall. Based on the DNR stream hydrography GIS coverage, there are approximately 28,607 stream-miles (both fish-bearing and non-fish streams) in these WRIAs, with an average stream density of 7.91 stream miles per mile squared. This is the highest stream density among the 12 regions of the State, and reflects the high rainfall of the region, but also the fact that stream surveys are probably more complete in this region of the State.

Habitat

Land cover and use. Forestland makes up approximately 89 percent of these WRIAs, ranging from 84 percent in the Upper Chehalis WRIA to 91 percent in the Willapa WRIA. Agricultural lands comprise 6 percent of the region, and they are particularly prevalent in the river valleys of the Upper Chehalis WRIA, where they make up 13 percent of the WRIA. An analysis for road density in the region yielded an average road density of 4.3 miles per square mile (WDNR 2004).

Forest ownership and management. Approximately six percent of all lands in these WRIAs are in Federal ownership and one percent of all lands are being managed in a Federal long-term preservation status, primarily in national parks, national wildlife refuges, and wildernesses. Tribal lands represent less than one percent of the region. State lands (primarily under management for timber production) represent 14 percent of all lands in the region, private lands represent 78 percent, and city/county lands represent about one percent. Private lands dominate the entire region, except for the northern portion of the Lower Chehalis WRIA and a coastal strip along the western boundaries of the Lower Chehalis and Willapa WRIAs. Private ownership is most prevalent in the Willapa WRIA (85 percent) and least prevalent in the Lower Chehalis WRIA (74 percent).

Approximately six percent of the forestlands in these WRIAs are in Federal ownership, 0.1 percent is in Tribal ownership, 15 percent are in State ownership, and 79 percent are in private or other ownership. Overall, lands covered by the forest practices rules represent approximately 93 percent of the forestlands in this region. This is the highest percentage among the regions of the State with substantial forestland acreage. Existing HCPs cover the vast majority (87 percent) of the State-managed lands, and a small portion (nine percent) of the private, county, and city ownerships.

The overall percentage of forestlands subject to the State forest practices rules ranges from 83 percent in the Lower Chehalis WRIA to 99 percent in the Upper Chehalis WRIA. The overall percentage covered by an HCP ranges from 14 percent in the Willapa WRIA to 27 percent in the Lower Chehalis WRIA.

Small, 20-acre exempt forest landowners make up about 0.8 percent of the forestlands and about 0.8 percent of the forestlands subject to forest practices rules in these WRIAs, based on the analysis by Rogers (2003). The small landowner parcels are mainly found in the lower elevation lands, especially along the major rivers. The highest percentage (about one percent of the forestland) is in the Upper Chehalis WRIA and the lowest percentage (0.4 percent) is in the Willapa WRIA.

Approximately 24,654 stream miles occur on lands subject to forest practices rules in these WRIAs. This represents 86 percent of all streams in the region. Approximately 13,820 miles or 56 percent of the 24,654 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be about 0.7 percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about one percent (Rogers 2003).

Sediment/mass wasting. The coastal hills are the most landslide-sensitive areas of the State because of the highly weathered marine sedimentary and volcanic bedrock. The degree of sensitivity depends on the underlying bedrock formation and the elevation of the hills. However, most of the underlying bedrock decays directly to sand, silt and/or clay, providing weak hillslope support, and providing little or no large substrate to armor the stream channels (WDNR 1996d). Heavy precipitation has also been conducive to erosion and landslides. The geological consequences of highly weathered marine sedimentary and volcanic bedrock and heavy precipitation are relatively short steep slopes and low gradient stream channels. Most of the watershed analyses inventoried hundreds of SRLS, including 1,100 landslides in one (WDNR 1997f) and 675 landslides in another (WDNR 1994b and 1994c; WSCC 2001b; WDNR 1996d; 1997f). Only the Palix Watershed landslide inventory recorded less than 100 SRLS (WDNR 1997f). Forest roads, and to a lesser extent, clearcut harvesting on steep slopes, helped trigger most of these landslides. Lands prone to SRLS are often managed for forestry, because they are unsuitable for most other uses. Deep-seated landslides and slumps occur in certain geological formations, and are scattered throughout the coastal foothills (WDNR 1994b; 1994c; 1996d; 1997f; 1997g; 1997h; 1997i).

Landslides are not a factor in the Chehalis Valley; however, streambank erosion is a problem in some areas and a significant source of fine sediment. Loss of riparian forests to agricultural and urban land uses is a primary cause of stream bank erosion. Increased peak flows from loss of soil permeability may also be a factor (WSCC 2001b).

The underlying geology and heavy rainfall in the coastal foothills results in sensitivity to road surface erosion. Unpaved forest and rural residential roads require significant maintenance to minimize sediment delivery to channels. In some areas, hard rock for road surfacing is difficult to find (WDNR 1997f; 1997g; 1997h; 1997i), and the next best available material must be used for road surfaces. This has led to extensive gravel mining of river alluvium in the Humptulips and Hoquiam River basins, and has contributed to other fish habitat impacts (WSCC 2001b). Lower gradients in the Chehalis Valley minimize surface erosion from unpaved roads; however, there may be pockets of locally significant surface erosion.

Riparian/floodplain and wetland conditions. Past old-growth timber harvest included the removal of riparian trees. In these WRIAs, this harvest practice started in the early 1860s and was substantially completed by the 1960s. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zone along many agricultural areas are now dominated by alder, invasive canary grass and blackberry, and provide substantially reduced shade and LWD recruitment. It is difficult or impossible for native conifer to re-establish in buffers with these vegetative characteristics. The limiting factors reports (WSCC 1999f; 2001b) made frequent note of the deficiencies in riparian buffers on agricultural and urban lands. A photometric study by Lunetta et al. (1997) suggests that functional riparian buffers in agricultural and urban areas are substantially lacking.

For those riparian areas that remained in timber production, riparian stands harvested prior to 1972 were often allowed to regenerate naturally, although riparian harvest since 1972 has benefited from mandatory conifer regeneration requirements. Since the soils in many riparian areas are moist, hardwoods currently dominate most of the riparian buffers that are forested.

The Chehalis Valley floodplain has seen extensive conversion to agricultural land use. Streambank damage and erosion by livestock are scattered throughout the region (WSCC 2001b). Agricultural activity has also occurred in the floodplains of smaller coastal rivers, including the Humptulips, Wynoochee, Satsop and Willapa valleys. The Chehalis Valley has also experienced industrial and urban development near the river mouth (in Cosmopolis, Washington) and in the upper valley (Chehalis and Centralia). Rural residential development has occurred on the flatter and more accessible land throughout this region.

Limiting Factors Analyses (WSCC 1999f; 2001b) don't mention extensive pre-Euro-American freshwater wetlands in the main river valleys, such as the Chehalis. It is unclear whether this is an oversight, lack of historic information, or that freshwater wetlands were not very extensive in comparison to the Puget Sound River valleys. Small valleys in the coastal foothills contain many small wetlands along low gradient channels. Beaver thrive in these small low gradient channels, and most of these wetlands are a result of beaver dams (WDNR 1996d; 1997f; 1997g; 1997h; 1997i).

Channel/hydrology conditions. The widespread agricultural and urban conversion in the Chehalis Valley has reduced the percolation of precipitation into the soil, and has likely contributed to scour and stream bank erosion.

Loss of forest canopies can substantially increase peak flow events because of what is referred to as rain-on-snow runoff, which occur when heavy warm rain falls on a snow pack. However, this region generally lacks extensive areas above 1,200 feet, necessary to accumulate heavy snow packs. The Stillman Creek drainage and south Olympic foothills are the only areas in the region high enough in elevation to trigger this concern (WDNR 1995c; 1997h).

The extensive network of forest roads may contribute to increased peak flows. Road ditches may act as an extension of the channel network, accelerating runoff and increasing the peak flows. Cross-drains and other BMPs may mitigate this effect, and local soil characteristics may vary the response. The existence and severity of road network effect is still subject to research and debate (Whemple 1994).

Estuarine and nearshore habitat. Southwest Washington has two large estuaries, Grays Harbor and Willapa Bay. Willapa Bay is one of the leading oyster producing estuaries in the nation, and Grays Harbor is also a major producer.

Grays Harbor differs from Willapa Bay in that industrial and urban developments are much more extensive, mostly associated with forest products. It is also a major industrial port. In the 1980s, paper mill wastes were identified as a significant contributor to the low survival of Chehalis River coho. Much of this has been cleaned-up, however other industrial toxic discharges, and the storage of toxins in sediments from historic industries remain a concern. Roughly 30 percent of the Grays Harbor estuary (presumably both inter-tidal marshes and mudflats) has been lost to industrial and urban development, including containment of dredge spoils. The environmental condition of the outer harbor is indeterminable. Marine water quality standards for temperature and dissolved oxygen have been exceeded, but these violations appear to be natural (WSCC 2001b).

Willapa Bay is the most undeveloped large estuary in Washington State. Several towns and fishing ports exist around the margins; however, major industries are lacking. The economy is largely based on natural resource extraction (timber, fishing, agriculture and oysters) and some tourism. Draining and diking for livestock production have reduced inter-tidal marshes by roughly 25 percent in the north end of the Bay (North, Willapa and Palix estuaries) and less than five percent in the south bay area (Nemah, Naselle and Bear estuaries) (WSCC 1999f). Exotic spartina has invaded both estuaries and is subject to ongoing eradication efforts. This grass can easily invade the open mudflats and drastically change the appearance of the bay (WSCC 1999f, 2001b). The coastal nearshore area in this region is composed of mostly sandy beaches. The beaches have not experienced much modification in historic times.

Large woody debris. The recruitment of LWD has been impacted by past riparian forest harvest and, on lands converted to other uses, the failure to re-establish these riparian forests following harvest. While near-term recruitment ranges from 60 to 80 percent in the Upper Skookumchuck, West Satsop, Palix, and Fall River watersheds (WDNR 1995c; 1996d; 1997f; 1997g; 1997h; 1997i), the outlook for long-term LWD recruitment is good on most stream reaches in the region. In addition, 64 percent of the Chehalis Headwaters is categorized as having good near-term LWD recruitment potential (WDNR 1994d). The retention of in-channel LWD has been impacted by its removal for navigational purposes, dikes and levee interference, debris torrents, and its historic removal as a misguided fisheries management tool.

Fifty-two percent of riparian stands on private lands in southwest Washington are dominated by hardwoods (Marshall and Associates 2000). Hardwoods do not grow to the size of conifer, and rot more quickly. Thus, they are not as functional as conifer is for LWD. However, hardwoods, especially alder, are an important source of nitrogen, which may be more important in the small channels that don’t readily flush leaf-litter (Wipfli and Gregovich 2002).

Beavers are a beneficial factor in this region. As noted above, they thrive in the smaller low gradient channels common in the coastal foothills. Beavers actively recruit LWD and build small dams, creating large ponds and trapping fine sediment. Thus, the beavers create many of the conditions as LWD that is recruited by other methods (WDNR 1996d; 1997f; 1997g; 1997h; 1997i).

One issue of notable regional interest is the widespread use of splash-dams to transport timber downstream to mills between 1890 and 1920. All logjams were systematically removed prior to the start of log drives. Splash dams of various sizes released pulses of high velocity water periodically to facilitate log transportation. The locations of over 130 splash dams were documented by Wendler and Deschamps (1955). River transportation of timber did severe damage to fish habitat. This included the loss of stable logjams, obstructing upstream passage, removal of riparian trees and vegetation, extensive bank damage, streambed scour and channel incision. By the 1920s, river transportation ceased in favor of rail and road transportation, and many dams were abandoned. In the 1930s, most of the remaining dams were destroyed to restore fish passage (Wendler and Deschamps 1955). Residual habitat effects from river transportation still persist.

Fish passage and barriers. Hundreds of known and potential culvert blockages have been documented in the Chehalis Basin (WSCC 2001b). However in the past decade, fish passage through forestry, agricultural and urban road culverts has been an area of renewed interest and funding.

The Wynoochee River Dam has upstream and downstream fish passage facilities. The downstream passage facilities are still only partially effective, however, self-sustaining runs of coho and other species return to the upper river. The Skookumchuck Dam has upstream passage facilities, which are used to pass steelhead above the dam.

Water quality. Many river and stream segments throughout this region do not meet state water quality standards for temperature. Dissolved oxygen water quality violations are also relatively widespread.

Natural factors have contributed, in part, to the water temperature problem, including low elevations throughout the region, wide channels, low water velocity, lack of heat exchange with the streambed as a result of widespread fine sediment, and numerous beaver ponds (WSCC 1999f; 2001c). In addition, agricultural and urban development has reduced the riparian canopy throughout most of the river valleys. Livestock has removed shade and trampled vegetation. In the past decade, there have been extensive efforts to fence livestock out of riparian buffers. National Park and National Forest lands are limited to the far upper end of the Wynoochee, Satsop and Humptulips Basins (Southern Olympics). As a result, there are almost no old-growth riparian buffers remaining. Roughly half the second growth riparian buffers are alder-dominated, which lack the height to provide shade on larger channels. While some actions can be accomplished to protect riparian buffers and allow trees to grow, this region is naturally sensitive to shade (Rashin and Graber 1992). In WRIA 22, the Upper Humptulips River has a TMDL for temperature (Peredney 2001).

In addition to temperature, low dissolved oxygen is a problem in the Black River and central

Chehalis River (WRIA 23), where water is deep, and velocity is slow. The Upper Chehalis River and its tributaries have TMDLs for temperature (WDOE, 2001) and for dissolved oxygen (Jennings and Pickett 2000). A significant fish kill occurred in the Black River. Nutrients from agricultural and industrial sources have contributed to the problem (WSCC 2001b).

The Willapa River, North River and some tributaries (WRIA 24) are impaired by high temperatures. The Willapa River is also impaired by low dissolved oxygen (WSCC 1999f.

Chemical use in forestlands is substantially limited to herbicide applications to suppress alder, maple, and brush competition during early phases of conifer forest regeneration. There are no regional factors to suggest that impacts from herbicides would be different from other regions in Washington State.

Hydropower

Medium-sized dams currently exist on the Wynoochee River and Skookumchuck River. These dams capture the sediment and contribute to channel incision and bedrock dominated channels downstream. Gravel supplementation is currently occurring at the Wynoochee Dam. Both the Wynoochee Dam and the Skookumchuck Dam use storage to enhance summer flows (WSCC 2001b).

The Wynoochee River Dam has upstream and downstream fish passage facilities. The downstream passage facilities are still only partially effective, however, self-sustaining runs of coho and other species return to the upper river. The Skookumchuck Dam has upstream passage facilities, which are used to pass steelhead above the dam.

Summary of Factors Affecting Covered Species in these WRIAs

With forestry making up a majority of the land use in this region, the condition of the environmental baseline ranges from landslide and erosion caused sedimentation to water temperature problems. The lack of historical old-growth conifer riparian vegetation, shifts in riparian vegetation composition, and total removal of riparian vegetation as a result of agricultural and urban conversion has led to limited LWD, shifts in vertebrate community structure, water quality limitations, and shifts in channel morphology. Estuarine conditions have been impacted by invasive species such as spartina grass which causes ecosystem simplification. Road culverts, remnants of riverine splash-dams and a few hydropower dams block fish passage throughout the region.

Factors Affecting Unlisted Species in Southwest Washington WRIAs. Coho are found in most accessible rivers and streams and are probably the most widespread anadromous fish in the Southwest region. A Washington Department of Fish and Wildlife hatchery located in the Willapa basin annually produces large numbers of coho fingerlings and yearlings which are stocked throughout Willapa bay. Coho are also stocked in the Stillman and Chehalis watersheds.

The Willapa Bay coho stock is considered to be a mixed stock of composite production. From 1952 through 1982, eggs were periodically transferred from other areas in Washington to

Willapa hatcheries and later released into the basin. Non-native eggs include: Green River, Dungeness, Simpson, Satsop and Humptulips stocks. Native stocks have been substantially replaced with naturally spawning hatchery stocks.

The Chehalis River coho stock is also considered to be a mixed-origin stock. Large numbers of fingerlings and yearlings have been introduced since the 1950s. Non-native eggs include Green River, Minter Creek, Samish River, Dungeness, Simpson, Lake Creek and Humptulips stocks. The stock status is considered healthy (WDF & WWTIT 1993).

Chinook in this region are anadromous Pacific salmon that exhibit both ocean- and stream-type strategies. In the Willapa basin adult fall Chinook return to their natal streams during July through early December. Spawning begins in late September and is completed by mid-November. Fall chinook represent nearly all Chinook production. This stock is considered to be of mixed stock of composite production. From 1954 through 1974, eggs from other areas of Washington were periodically brought to Willapa hatcheries and later released into the basin. Hatchery strays contribute significantly to wild production in the basin. Willapa Bay fall chinook are thought to use the lower reaches of Redfield, Martin and Raimie Creeks and suitable riffles in the vicinity of the confluence of Fall and North Rivers. The stock status is considered healthy (WDF & WWTIT 1993).

An early run of fall chinook is found only in Fall River and the mainstem North River near its confluence with the Fall River. These fish are thought to return to their natal streams in August and complete spawning activity by mid- to late-October. Little information is available on distribution, run timing or contributions to fisheries, but the status of this stock is thought to be depressed. The Fall River early fall chinook is considered to be a native stock supported by wild, rather than hatchery production.

Chehalis River fall Chinook are considered a hybrid species with significant native genetic characteristics. Fingerling and fry releases occurred from the early 1950s through the early 1970s. Little information is available regarding the success of the releases, but it is hypothesized that some fish returned to spawn. The stock status is considered healthy. The Chehalis River spring chinook stock is considered to be native origin, with wild production. Although some Cowlitz hatchery stock were introduced in the Wynoochee River in the 1970s, returns were minimal and have declined to near zero. The overall stock status is considered healthy (WDF & WWTIT 1993).

In the Willapa basin, chum begin their upstream migration in October and spawn from late October through early December. The fry hatch in late winter and outmigrate within a few days after emerging from the gravel, usually February through March. Chum salmon are known to utilize the lower North River below RM 10, and have been found as far upstream as RM 27. The Willapa Bay North River chum stock is considered to be a native stock with wild production. The stock status is considered healthy (WDF & WWTIT 1993).

The Willapa Bay North River/Smith Creek winter steelhead stock is considered to be a wild stock sustained by natural production. The stock origin is native with no hatchery supplementation on later returning stocks. The Willapa Hatchery typically does not handle steelhead. Some fish are trapped and donated for use in local volunteer enhancement projects. Most of these are stocked in the Willapa system. The stock was historically composed of a small number of fish that colonized the North River after removal of an anadromous blockage in the mid-1940s. The current stock status is unknown. The Willapa Bay North River/Smith Creek winter steelhead stock is likely to occur in the tree farm area in reaches accessible to anadromous fish, but distribution data are unavailable.

Winter steelhead in the Chehalis River are considered to be a native and distinct stock based on geographical isolation of the spawning population. The stock status is considered healthy (WDF & WWTIT 1993).

While sockeye salmon were presented in the DEIS (Appendix A) as occurring in the Lower Chehalis River (WRIA 22), WDFW has confirmed that sockeye presence in not currently know for this watershed and that this was an error in the database (pers. comm. Terry Jackson 2005).

The lack of ESA-listed ESUs may relate to the low effect that the baseline conditions have had on all of the salmonid species. The best available science, generating from the State during the early 1990s identified all of the stocks as healthy (WDF & WWTIT 1993). More recent surveys may indicate different findings. Until such time as more current information is available, NMFS must conclude that the environmental baseline poses a low risk to the existing salmon stocks in these WRIAs.

2.1.3.4.10 Olympic Coast Watershed Resource Inventory Areas. The Olympic Coast WRIAs (19, 20, and 21) include the Hoko, Pysht, Sekiu, Soleduc, Hoh, Quillayute, Queets, Copalis, Quinault and Clearwater River Basins, as well as other smaller tributaries. This area includes portions of Clallam, Jefferson, Gray's Harbor, and Mason Counties. In May 2005, NMFS reviewed the Public Consultation Tracking System it maintains as a database of consultations conducted since 1999. During that review, NMFS could not identify any formal interagency consultations conducted in this analysis region. The effects of other past and present actions in these WRIAs can be relevant to the biological requirements of listed Ozette Lake Sockeye, several unlisted salmonids, and the unlisted non-salmonid species addressed in this consultation.

Hydrology

The region contains multiple rivers, all of which originate in the Olympic Mountains. The Hoko and Pysht rivers flow north into the Strait of Juan de Fuca while the Sol Duc, Hoh, Queets, and Quinault flow west into the Pacific Ocean. Fall and winter rain events produce peak flows in the Hoko and Pyhst rivers. In higher elevation basins such as the Sol Duc, Hoh, Queets, and Quinault rivers, peak flows result both from rain and rain-on-snow precipitation events. Smaller magnitude peak flows in higher elevation basins sometimes result from spring snowmelt. Low flows generally occur during late summer or early fall. Based on the DNR stream hydrography GIS coverage, there are approximately 14,959 stream-miles (both fish-bearing and non-fish streams) in the Olympic Coast WRIAs, with an average stream density of 5.45 stream miles per square mile.

Habitat

Land cover and use. Forestland makes up approximately 95 percent of the Olympic Coast region. Water and wetlands and ice, snow and bare rock each comprise two percent. The proportion of forestland ranges from 95 to 96 percent across all WRIAs. An analysis for road density in the region yielded an average road density of 3.6 miles per square mile (WDNR 2004).

The Olympic Mountains are largely within the Olympic National Park. The area is characterized by extensive temperate rainforests interspersed mostly at higher elevations with alpine meadows, rock, glaciers and snowfields. Timber harvest or road construction is limited in extent.

The western portion of the region is mostly rainforest, and much of it has been subject to timber harvest at least once. Extensive clearcut timber harvest along the Strait of Juan de Fuca started in the 1900's. The harvest of old growth stands continued into the 1980s in parts of the Hoh, Queets and Quinault basins, where visible impacts still linger. In general, the timber harvest started later here than in other regions of western Washington. Heavy rainfall and remoteness from existing urban areas had discouraged agricultural and residential development; however, small towns and communities are scattered throughout the region. Most of the lands outside the Olympic National Park and USFS Wilderness Areas are managed for timber. Historic timber harvest, road construction and forest fires have had substantial impacts on salmon habitat (WSCC 1999e; 2000b; 2001a).

Forest ownership and management. Approximately 41 percent of all lands in the Olympic Coast region are in Federal ownership and the majority of these (representing 30 percent of all lands) are being managed for long-term preservation, primarily in national parks, national recreation areas, and wildernesses. Tribal lands represent about 13 percent of the region; they consist mostly of the Quinault Indian Reservation in WRIA 21 and the Makah Indian Reservation in WRIA 19, along with several smaller reservations. State lands (primarily under management for timber production) represent 18 percent of all lands in the region, private lands represent 27 percent, and city/county lands represent less than 0.5 percent.

Generally the upper portions of the basins are in Federal ownership in Olympic National Park and Forest, and the lower basins are in private ownership. The Lyre-Hoko WRIA (19) is 53 percent in private ownership, four percent in Tribal ownership, and 19 percent in Federal ownership. In contrast, the Queets-Quinault WRIA (21), 13 percent in private ownership, 27 percent in Tribal ownership, and 43 percent in Federal ownership.

Small, 20-acre eligible forest landowners make up about 0.3 percent of the forestlands and about 0.7 percent of the forestlands subject to forest practices rules in the Olympic Coast region, based on the analysis by Rogers (2003). The small landowner parcels are mainly found in the lower elevation lands, especially along the major rivers. The highest percentage (about 0.8 percent of the forestland) is in the Lyre-Hoko WRIA (19) and the lowest percentage (0.2 percent) is in the Queets-Quinault WRIA (21).

Approximately 7,480 stream miles occur on lands subject to forest practices rules in the Olympic Coast region. This represents 50 percent of all streams in the region. Approximately 4,773 miles or 64 percent of the 7,480 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre eligible forest landowner parcels in this region is estimated to be about 0.4 percent and the percentage of all fish-bearing streams on small, 20-acre eligible forest landowner parcels is about 0.8 percent (Rogers 2003).

A dataset used by Lunetta et al. (1997) showed that 16 percent of the RRRBs were classified as late seral stage. Nearly four percent of the RRRBs were unforested, primarily as a result of urban and agricultural development. This is the lowest of any of the Western Washington regions. Likewise, 64 percent of the RRRBs are either mixed or conifer-dominated, the highest of any Western Washington region.

One notable statistic is that 48 percent of the RRRBs are in either early- or mid-seral stages, the highest of any Western Washington region. Two potential reasons probably account for this. First, timber harvest in much of this region occurred later than in other parts of the state. Second, riparian buffers in this region remained in forestry use, whereas forestlands in other regions were often converted to agricultural and urban land uses following harvest.

The 31 percent of riparian buffers defined as “other forestlands” is similar to other regions. Marshall and Associates (2000) estimated that approximately 55 percent of the private and tribal fish-bearing riparian buffers were alder-dominated. Since Lunetta et al. (1997) included Federal forestlands in their survey, and much of this Federal land is old-growth in the Olympic National Park, these facts suggest that most “other forestland” is hardwood-dominated. Although Lunetta et al. (1997) and Marshall and Associates (2000) had different metrics and objectives, their information appears to complement each other on the issue of hardwoods.

In summary, the Olympic Coast region has experienced a lower rate of agricultural and urban development along streams and rivers. Because old-growth timber harvest in this region occurred later than in other regions, many of the conifer-dominated and mixed riparian stands are at an earlier stage of post-harvest recovery. Similar to other regions, a significant part of the harvested riparian stands regenerated as hardwoods, placing these stands on a much longer pathway to LWD recovery.

Sediment/mass wasting. In the Olympic Mountains, the natural incidence of SRLSs is high. The limited forestry that has occurred has triggered slides (WDNR 1999), causing downstream effects. The valleys of the western portion of the region lack the gradients for mass wasting, except along river channels where banks and high terraces are prone to collapse. While some stream bank collapse is natural, harvest of the riparian timber has removed the root strength needed to support banks, and contributed to sediment and the loss of very large LWD (whole tree) recruitment. The decline of large in-channel LWD has caused channel incision in some places, which increases bank heights and the frequency of bank collapses (WSCC 1999; 2000b).

The quantity of natural and forestry-related SRLSs is very high in many of the higher foothills because of steep gradients, high precipitation and weathered sandstones. The SRLS represent the most severe environmental impact in these areas. However, the lower foothills such as the Dickey River drainage (WSCC 2000b) and the Raft River (WDNR 2002a) are less sensitive to SRLSs. Watershed analyses in this region have documented hundreds of SRLS and debris torrents associated with forest roads and timber harvest. While watershed analyses have targeted the watersheds with the worse history of mass wasting, the pattern is consistent, and most of these higher foothills appear to be vulnerable to SRLSs (WDNR 1995b; 1996c; 1997d; 1997e; 2002a; WSCC 1999e; 2000b). A forest fire in 1951, led to significant damage and numerous landslides in the North Fork Calawah Basin.

The Salmon River Watershed Analysis in WRIA 21 (WDNR 2002b) noted several active and numerous potential DSLSs. Two types appear to exist. One type forms on the outside of river meanders in the alluvial and glacial deposits in the valley, and the other forms in deep weathered rock on the higher hills. Only a few other DSLSs were documented in the region.

Besides mass wasting problems, forest roads in the sandstone foothills produce substantial amounts of fine sediment. Cutslopes, ditches and fill slopes readily produce fine sediments, especially following construction or rehabilitation when they lack vegetative cover. Fine sediments from roads and mass wasting are identified as the most significant habitat limiting factor in all the western Strait of Juan de Fuca drainages (WSCC 1999).

Riparian/floodplain and wetland conditions. Limiting Factors Analyses (WSCC 1999; 2000b; 2001a) have noted that roadbed construction has confined the active channel in many floodplains. Channel confinement prevents natural channel meander and LWD recruitment and blocks access to off-channel habitat, which has been clearly identified as important habitat for coho and other species in this region (Cederholm et al., 1988). Many floodplains in this region are described as being in poor condition (WSCC 2000b; 2001a). Road construction has occurred as a result of timber harvest, residential development and public transportation.

No large wetlands were noted in the regional literature. The floodplains, and low gradient foothills (e.g., the Dickey River in the Sol Duc drainage) have many small wetlands; some of which are forested and some are open water. Beaver play a role in creating many of these wetlands. Road construction alters surface drainage and blocks fish access to some wetlands. Wetland draining for agricultural and residential development has occurred, but the extent is poorly documented.

Channel/hydrology conditions. This region has no major hydropower dams or municipal water withdrawals. Urban development is relatively sparse, and partially concentrated along the coastline where effects on freshwater channels are limited. Agriculture is also limited in extent. Rain-on-snow peak flows occur primarily on clearcuts above 1200 feet in elevation. Some of the high foothills that are managed for timber have extensive stands above 1200 feet elevation (WDNR 1995b; 1996c; 1997d; 1997e). The extensive existing network of forest roads may contribute to increased peak flows by road ditches acting as an extension of the channel network, accelerating runoff and increasing the peak flows. The existence and severity of a road network effect is still subject to research and debate. A detailed analysis of long term hydrological data from two gauges on the Quinault River found no evidence that human disturbance has affected peak flows (WDNR 1999). However, impacts may occur at small drainage scales.

Estuarine and nearshore habitat. Estuaries throughout this region are naturally smaller comparable to drainages in Puget Sound and Southwest Washington. Steep marine hillslope gradients, currents, heavy wave action, and geologically recent continental glaciation in the Strait of Juan de Fuca have not been conducive to the formation of large deltas and associated estuaries. However, small estuaries occur at the mouths of most rivers and streams. A number of the Strait of Juan de Fuca estuaries have recently been disturbed by substantial mass wasting deposits, caused both by forest practices and by natural processes. Road construction has constrained tidal and floodwater circulation in some of these small estuaries, such as Salt Creek and Soes River (WSCC 1999e; 2000b), reducing rearing habitat for juvenile salmon transitioning to the ocean.

In WRIA 19 and WRIA 20, the nearshore habitat is substantially composed of rocky substrates with occasional sand or gravel beaches. The rocky nearshore areas support extensive kelp beds. While many kelp beds provide cover for adult and possibly juvenile salmon, evidence linking salmonid survival rates with kelp beds is currently lacking. In WRIA 21 (Queets, Quinault, Moclips, Copalis drainages) sandy beaches prevail, although rock outcrops are still common.

The shorelines in this region are extensively protected by parks and tribal lands. Although the beaches in southern WRIA 21 have experienced some residential and recreational development, the nearshore habitat is in good condition compared to other regions.

Large woody debris. The recruitment of LWD has been affected by past riparian forest harvest. In addition, on lands converted to other uses, the failure to re-establish these riparian forests following harvest has significantly limited the availability of LWD. The retention of in-channel LWD has been impacted by its removal for navigational and misguided habitat enhancement efforts, dikes and levee interference and debris torrents.

In the Olympic Mountains and the higher foothills, landslides are the primary means of LWD recruitment, although adjacent riparian recruitment is still important. Smaller woody debris is transported during very high peak flows which are caused by high gradients and precipitation. In the large floodplain channels, very large conifer LWD with attached rootwads is required to achieve LWD functions (Abbe and Montgomery 1996). Dikes and levees are few in this region. However, floodplain roadbeds are more prevalent and can reduce LWD recruitment by constraining channel meander and recruitment (WSCC 1999e; 2001a). Old growth harvest occurred in the 1970s and 1980s in parts of the Hoh, Queets, and Quinault drainages, leaving little or no riparian vegetation (WDNR 1999; WSCC 1999e; 2001a). Alder regeneration following riparian timber harvest is a significant impact to future LWD recruitment throughout this region (WSCC 1999e; 2000b; 2001a). Reed canary grass was identified as a factor preventing the regeneration of riparian forests (WSCC 1999e).

Fish passage and barriers. The Olympic Coast region has no major hydropower facilities. However, there are numerous culverts that partially or completely act as barriers to fish passage in WRIA 20 (WSCC 2000b). These fish passage barriers occur on various land ownerships.

Water quality. High water temperatures have been documented in many locations, typically at lower elevations (WSCC 1999e, 2000b, 2001a). Some of these temperature exceedances are natural, either caused by an upstream lake, a wide channel, or in one case, a geological formation. In other situations, riparian harvest and canopy reduction, sometimes resulting from mass wasting, contribute to high water temperatures. Alder riparian stands frequently contribute to high water temperatures. Alder lacks the tree height and the foliage density of conifers, and does not provide the same shade.

Turbidity from mass wasting and road surface erosion was also identified as a water quality issue in several Strait of Juan de Fuca (WRIA 19) streams. Specifically, Deep Creek is impaired by fine sediment from a mass wasting event. Waters impaired by high temperatures in WRIA 19 include Deep Creek, the Clallam River and the Sekiu River (WSCC 1999e).

A number of coastal streams in WRIA 20, including the Big River and the Soleduc River, were found to have low pH. This appears to be largely natural, although the accumulation of cedar wastes from cedar bolt cuttings may be locally significant (WSCC 2000b). WRIA 20 also has several waters that are considered impaired for temperature, including the Bogachiel, Dickey, and Soleduc Rivers.

Industrial or municipal pollution is not a habitat limiting factor (WSCC 1999e; 2000b; 2001a). However, one municipal wastewater treatment facility in the southern part of WRIA 21 was believed to contribute to a dissolved oxygen condition in Joe Creek, a small independent drainage.

Pinniped/mammal Predation. Recent studies by NMFS and the Makah Tribe suggest that predation rates on adult sockeye salmon by river otters, harbor seals, and sea lions in Ozette Lake and adjacent marine areas are considerable, and a potential factor for decline of the listed sockeye population (Gearin et al., 1998; MFM 2000). These mammals are also likely to feed upon the carcasses of adult sockeye salmon after the fish have spawned in the tributaries and lake. Interactions between river otters and adult sockeye salmon occur in the Ozette River and likely in the lake. Direct observations of otters preying on adult sockeye were recorded in 1998, 1999, and 2000. In 1999, video footage recorded three instances of direct otter predation on adult sockeye, which included footage of adult sockeye being carried to and from Ozette Lake. In a recent study, adult sockeye scarring rates between marking at the river mouth, and recapture at the lake outlet ranged from 13 percent to 17 percent in 2000 (MFM unpublished data). Harbor seal habitat utilization overlaps extensively with adult sockeye salmon during their migration up the Ozette River from April through late-July. Harbor seals migrate up the Ozette River into Ozette Lake and seal predation attempts on adult sockeye salmon have been observed at the mouth of the river, and at the lake outlet. The frequency of seal/sockeye interactions appears to directly correlate to Ozette River flow and the tidal cycle affecting the lower river (Gearin et al., 1998; MFM unpublished data).

The MFM staff collaborated with the Lake Ozette Steering Committee to identify factors for decline of Ozette Lake sockeye salmon since early 2002. Preliminary limiting factors identified by the Tribe and the committee to NMFS for the 2003 status review process were: (1) loss of adequate quality and quantity of spawning and rearing habitat, (2) predation and disruption of natural predator-prey relationships, (3) introduction of non-native fish and plant species, (4) past over-exploitation, (5) poor ocean conditions, and (6) interactions among those factors (MFM 2000).

More specifically, within the Olympic Coast WRIAs present both forestry and non-forestry related habitat limitations. Those include high road densities, high sedimentation rates, lack of LWD, loss of riparian conifer cover and poor riparian recruitment, hardwood conversion, channel confinement/incision and loss of hydrologic maturity, roads in floodplain, conversion from late-seral to early-seral mixed forests, channel clearing activities, dredging, bank armoring, diking, road fills and undersized culverts, and bank hardening (SSHIAP 2004).

2.1.3.5 Fisheries Harvest in the Environmental Baseline

Treaty Indian fishing rights are not effects of past and ongoing actions on habitat perse, but are included in the discussion of the environmental baseline for this consultation at the request of certain western Washington Treaty Tribes. Certain Washington Tribes (Yakama, Cowlitz, Hoh, Lummi, Makah, Muckleshoot, Nisqually, Nooksack, Puyallup, Quileute, Quinault, Sauk-Suiattle, Upper Skagit, Lower Elwha, Jamestown, Port Gamble, S'Klallum, Skokomish, Snoqualmie, Squaxin Island, Stillaguamish, Suquamish, Swinomish, Tulalip, Pend d'Oreille), and two with reservations outside of Washington (Nez Perce, Umatilla) entered into treaties with the United States in 1855. In exchange for the Indians relinquishing their interest in certain lands, the treaties reserved to the Tribes "exclusive" on-reservation rights and the right to take "fish at all usual and accustomed places in common with citizens of the United States" outside the reservations on the Columbia River, Puget Sound, major tributaries, Hood Canal, and the Strait and ocean.

Treaty fishing rights (among others) are reserved rights that generally date from time immemorial. See, Felix S. Cohen, Handbook of Federal Indian Law, 441-448 (1982); United States v. Winans, 198 U.S. 371, 381 (1905), 25 S.Ct. 662, 49 L.Ed. 1089 ("In other words, the treaty was not a grant of rights to the Indians, but a grant of right from them -- a reservation of those not granted. . . . There was an exclusive right of fishing reserved within certain boundaries. There was a right outside of those boundaries reserved 'in common with the citizens of the territories.'"); United States v. Adair, 723 F.2d 1394, 1412-1414 (9th Cir. 1983), cert. denied sub nom Oregon v. United States, 467 U.S. 1252 (1984) ("Accordingly, we agree with the district court that within the 1864 Treaty is a recognition of the Tribe's aboriginal water rights and a confirmation to the Tribe of a continued water right to support its hunting and fishing lifestyle on the [former] Klamath Reservation. Such water rights necessarily carry a priority date of time immemorial.").

Treaty Indian fishing rights in the Columbia basin are under the continuing jurisdiction of the U.S. District Court for the District of Oregon in the case of *United States v. Oregon*, No. 68-513 (D. Oregon, continuing jurisdiction case filed in 1968). In *U.S. v. Oregon*, the court affirmed that the treaties reserved for the Tribes 50 percent of the harvestable surplus of fish destined to pass through their usual and accustomed fishing areas. In at least a half-dozen published opinions and several unpublished opinions in *U.S. v. Oregon*, as well as dozens of rulings in the parallel case in *U.S. v. Washington* (interpreting the same treaty language for Tribes in the Puget Sound area, see below), the courts have established a large body of case law setting forth the fundamental principles of treaty rights and the permissible limits of conservation regulation of treaty fisheries.

While the general principles for allocating fishing opportunity between non-indian and treaty Indian fishing rights are well established, their application to individual runs during the annual spring and fall fishing seasons can be difficult. Annual calculations of allowable harvest rates depend (among other things) on estimated run sizes for the particular year, on the mix of stocks that is present, on application of the ESA to mixed-stock fisheries, on application of the tenets of the "conservation necessity principle" to regulation of treaty Indian fisheries, and on the effect of both the ESA and the conservation necessity principle on treaty and non-treaty allocations. While the precise allocation of fishing opportunity during a particular fishing season often cannot be established by a rigid formula, the treaty fishing right itself continues to exist and must be accounted for in the environmental baseline.

The allocation in a particular year is subject to negotiations in *U.S. v. Oregon* and *U.S. v. Washington,* in which the parties seek to quantify the exploitation rate for the Tribal right and associated non-Tribal fishing, subject to ESA-imposed constraints for listed species. A critical harvest management issue under *U.S. v. Oregon* involves what are called "mixed-stock fisheries." Depressed or listed populations are often in the river at the same time as healthy and harvestable stocks of various hatchery and wild components of the runs and are caught incidentally in fisheries that target the healthy stocks.

Starting in 1977, Tribal and state fisheries subject to *U.S. v. Oregon* have been regulated pursuant to a series of court orders reflecting court-approved settlement agreements among the parties. The last long-term agreement, known as the Columbia River Fishery Management Plan ("CRFMP"), was adopted and approved by the Court in 1988 and expired in 1999. At the Court's direction and under its supervision, the parties are currently in the process of negotiating a new long-term agreement.

During the past 10 years, harvest has been managed pursuant to the CRFMP and successor agreements that contain restraints on the fisheries necessitated by the ESA listings of some of the ESUs. As a result, NMFS has conducted ESA Section 7 consultations and issued no-jeopardy opinions covering these agreements and their impact on ESA-listed species.

As of August 2004, there are two interim Court-approved settlement agreements in place in *U.S. v. Oregon*. One is a Spring Agreement entered into in 2001, which will continue to set harvest rates through spring of 2005; the other is the 2004 Fall Agreement, which will remain in effect through December 2004. Agreed-to and estimated harvest rates for various stocks under the current agreements are set forth in Tables 2 and 3, below. The inclusion of treaty rights harvest in the environmental baseline is descriptive only and is not intended to quantify legal entitlement or affect in any way any legal right or entitlement relating to treaty fishing rights. For the purpose of projecting the environmental baseline into the future, the tribal treaty right must be included as indicated. In terms of the analysis in the Opinion, it does not matter whether the tribes harvest all of the harvest available to them or, as has been the practice, allocate a portion of that harvest to the states. Accordingly, in order to estimate the extent of this baseline harvest, NMFS will presume that treaty and non-treaty harvest rates comparable to the current harvest rates will continue into the future pursuant to Court-approved settlement agreements. In addition, the Colville Confederated Tribal fisheries have been consulted on and remain in effect

Table 2. Expected harvest rates for listed salmonids in winter, spring, and summer season fisheries in the mainstem Columbia River and in tributary recreational fisheries under the 2001 - 2005 Spring Agreement in U.S. v Oregon. NA - similar estimates not available for other areas. (Table modified from NMFS 2004a)

ESU	Non-Indian Fisheries		Treaty Indian Fisheries
	Mainstem	Tributary Fisheries3	Mainstem
Snake River fall chinook	0	0	0
Snake River spring/summer chinook	<0.5-	NA	5.0-15.0%1
Upper Columbia River spring	<0.5-	NA	5.0-15.0%1
Lower Columbia River chinook	2.7%2	NA	0
Upper Willamette River chinook	<15%4	4	0
Snake River steelhead			
A-run	0.2%	2.5%5	2.7%6
B-run	0	2.5%5	06
Upper Columbia River steelhead			
Naturally-produced	0.6%	NA	3.8%
Hatchery-produced	4.5%	NA	2.7%
Mid-Columbia River steelhead	<2.0%7	NA	3.6%
Lower Columbia River steelhead	<2.0%7	NA	1.6%
Upper Willamette River steelhead	<2.0%7	<1.2%	0
Lower Columbia River coho	0	0	0
Columbia River chum	0	08	0
Snake River sockeye	<1.0%	0	<7.0%

[1] Allowable harvest rate varies depending on run size.
[2] Spring component of the Lower Columbia River ESU only.
[3] Impacts in tributary fisheries will be population specific depending on where the fisheries occur.
[4] Harvest rate limited to 15 percent or less in all non-Indian mainstem and tributary fisheries.
[5] Maximum harvest rate applied to wild fish passing through terminal fishery areas where hatchery fish are being targeted; hooking mortality of 5 percent applied to an assumed 50 percent encounter rate. Harvest rates to stocks not passing through targeted terminal fishing areas will be less.
[6] B-run steelhead of the current return year are primarily caught in fall season fisheries. However, a portion of the summer steelhead run holds over in the Lower Columbia River above Bonneville dam until the following winter and spring; these fish, thought to be mostly A-run, are caught in fisheries in those seasons.
[7] Harvest rate limits for winter-run populations.
[8] Chum may be taken occasionally in tributary fisheries below Bonneville Dam. Retention is prohibited.

through October 2012.

Table 3. Expected harvest rates for listed salmonids in fall season fisheries in the mainstem Columbia River under the 2004 Fall Agreement in U.S. v Oregon. (Table modified from NMFS 2004a)

ESU	Non-Indian Fisheries	Treaty Indian Fisheries
Snake River fall chinook	8.25%	23.04%
Snake River spr/sum chinook	0	0
Upper Columbia River spring chinook	0	0
Lower Columbia River chinook		
Spring component	0%	0%
Tule component	12.4%	0%
Bright component	11.8%	0%
Upper Willamette River chinook	0	0
Snake River steelhead		
A-run	2% (1.1%)1	3.4%
B-run	2% (1.7%)1	15% (13.6%)1
Upper Columbia River steelhead		
Natural-origin	2% (1.1%)1	3.4%
Hatchery-origin	10.9%	5.7%
Mid-Columbia River steelhead	2% (1.1%)1	3.4%
Lower Columbia River steelhead	2% (0.3%)1	0.1%
Upper Willamette River steelhead	0	0
Lower Columbia River coho	6.4%	0
Columbia River chum	5% (1.6%)1	0%
Snake River sockeye	2	2

[1] Maximum proposed harvest rates with the expected harvest rates associated with the proposed fisheries shown in parenthesis.

[2] 8% cap (combined Tribal and non-Tribal harvest)

Puget Sound Chinook are caught in a broad range of fisheries, managed by an array of agencies, bodies and governments, including the U.S. Department of Commerce; States of Washington, Oregon, and Alaska; more than 20 Native American tribal jurisdictions; the North Pacific Fisheries Management Council; the Pacific Fisheries Management Council (PFMC); Canadian Department of Fisheries and Oceans; and the Pacific Salmon Commission (PSC). Salmon fisheries within Puget Sound and the Strait of Juan de Fuca are jointly managed by the WDFW and the Puget Sound treaty tribes, under the continuing jurisdiction of *U.S. v. Washington* (Civil No. C70-9213, Western District, Washington; see 384 Federal Supplement 312, Western District, Washington, 1974). *U.S. v. Washington* is the on-going Federal judicial process that enforces and implements reserved treaty fishing rights with regard to salmon and steelhead returning to western Washington. The Puget Sound treaty tribes include the Makah, Lower Elwha Klallam, Jamestown S'Klallam, Port Gamble S'Klallam, Suquamish, Skokomish, Squaxin Island, Nisqually, Puyallup, Muckleshoot, Tulalip, Stillaguamish, Sauk-Suiattle, Swinomish, Upper Skagit, Nooksack and Lummi tribes.

Findings of *U.S. v. Washington*, commonly referred to as the *Boldt* Decision, clarified these treaties with regard to allocation of salmon harvests between treaty tribal and non-tribal fishers, holding that Tribes are entitled to a 50 percent share of the harvestable run of fish. *Hoh v. Baldridge* (522 F.Supp. 683 (1981)) established the principle that where annual fishery management plans might affect an individual Tribe, the plans must take into account returns to individual streams, thus setting the framework for the management unit organization of the harvest information in Table 4, below. The Puget Sound Salmon Management Plan and the management agreements under *Hoh v. Baldridge* established principles governing the management of shared salmon resources and established the principle of co-management whereby Tribes are equal co-managers with the State and represent themselves in the regional and international management forums. The Puget Sound treaty tribes co-manage Puget Sound fisheries with the state of Washington, and participate with tribes from California, Oregon and other Washington areas in managing fisheries under the jurisdiction of the Pacific Fisheries Management Council and the Pacific Salmon Treaty.

The harvest of Puget Sound Chinook is co-managed by the Puget Sound Treaty Tribes and the State of Washington. The co-managers jointly produced the Puget Sound Chinook Harvest Management Plan (PSCHMP) which established rebuilding exploitation rates; a fishing regime setting exploitation ceilings for each Chinook management unit that eliminates directed fisheries on depressed Puget Sound Chinook while allowing incidental catch during other fisheries. In effect, the plan sets limits on annual fishery related mortality for each Puget Sound Chinook management unit (PSTT and WDFW 2004). Management units meeting the upper management threshold (third column in Table 4) will have a harvestable surplus. In contrast, commercial and recreational fisheries will be precluded for management units with abundance below their upper management threshold (i.e. lacking harvestable surplus). The low abundance threshold (fourth column in Table 4) is the level at which extraordinary conservation measures are triggered in the subject management unit (PSTT and WDFW 2004). NMFS qualified the Chinook Harvest Plan as a Resource Management Plan under Limit 4 of the July 2000 NMFS ESA section 4(d) Rule (July 10, 2000, 65 FR 42422) which action was also the subject of intra-agency consultation under ESA section 7 (NMFS reference number 2004/00731, December 14, 2004). As stated above, the inclusion of treaty rights harvest in the environmental baseline is descriptive only and is not intended to quantify legal entitlement or affect in any way any legal right or entitlement relating to treaty fishing rights.

Table 4. Puget Sound Chinook harvest management units with rebuilding exploitation rates, expressed either as either total, southern U.S. (SUS), or pre-terminal (PT) SUS percentage rates; with upper management thresholds, and low abundance thresholds (PSTT and WDFW 2004).

Management Unit	Rebuilding Exploitation Rate	Upper Management Threshold	Low Abundance Threshold
Nooksack[3]	Under	4,000	
North Fork	Development	2,000	1,000
South Fork		2,000	1,000
Skagit summer/fall	50%	14,500	4,800
Upper Skagit summer		8,434	2,200
Sauk summer		1,926	400
Lower Skagit fall		4,140	900
Skagit spring	38%	2,000	576
Upper Sauk		986	130
Cascade		440	170
Siuattle		574	170
Stillaguamish[1]	25%	900	650
North Fork summer		600	500
South Fork & MS fall		300	n/a
Snohomish[1]	21%	4,600	2,800
Skykomish		3,600	1,745
Snoqualmie		1,000	521
Lake Washington	15% PT SUS	1,200	200
Cedar River[1]			
Green	15% PT SUS	5,800	1,800
White River spring	20%	1,000	200
Puyallup fall	50%		500
South Prairie Creek		500	
Nisqually		1,100	
Skokomish	15% PT SUS	3,650 aggregate 1,650 natural	1,300 aggregate 800 natural
Mid-Hood Canal	15% PT SUS	750	400
Dungeness	10% SUS	925	500
Elwha	10% SUS	2,900	1,000
Western JDF	10% SUS	850	500

[1] Thresholds expressed as natural origin spawners.

Harvest of Hood Canal summer chum in Washington fisheries is co-managed under the Summer Chum Conservation Initiative (WDFW and PNPTT 2000). Harvest of summer chum will occur incidentally in fisheries directed at other species, in accordance with the stated Base Conservation Regime. The summer chum conservation initiative (SCCI) established upper limits for harvest impact on two summer chum management units. For the Hood Canal management units, the upper limit is 15.3 percent. For the Strait of Juan de Fuca management unit, the upper limit is 11.8 percent. NMFS qualified the SCCI under Limit 6 of the July 2000 ESA section 4(d) Rule (July 10, 2000, 65 FR 42422).

2.1.4 Effects of the Action

This section of the Biological Opinion presents the direct and indirect effects of the proposed action (issuing an ITP and covering unlisted species in the HCP and IA for the salmonids and other fish listed in Table 1). Effects include those of interrelated or interdependent actions, when such actions are identified during consultation. The purpose of the effects analysis is to determine whether, considering the status of the species and any critical habitat, the environmental baseline, and any cumulative effects, the proposed action is likely to jeopardize the covered species or destroy or adversely modify any designated critical habitat. The effects analyses examine the anticipated effects of the action in an action area of approximately 9.3 million acres of privately and publicly owned forestland in Washington State. For the critical habitat analysis, this Biological Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, the analysis looks to the statutory provisions of the ESA relevant to critical habitat, as provided in NMFS's November 7, 2005 memo to Regional Directors from Director William T.Hogarth (the Hogarth memo, Appendix A).

2.1.4.1 Analysis Approach and Assumptions

2.1.4.1.1 Introduction. In recent years, the decline and extinction of Pacific salmon populations and other fish species has been linked to habitat loss and degradation in their spawning and rearing streams (Nehlsen et al., 1991). Many of the same factors affecting salmonid habitat quantity and quality are relevant to habitat for the covered unlisted species. As a result, and because many forestry activities have the potential to adversely affect aquatic habitat, this consultation addresses the effects of those activities as they would be carried out under the FPHCP. The assessment of the effects of the action associated with the proposed ITP for the state of Washington is primarily focused on (but not limited to) habitat-based, and habitat-relevant effects are assessed for salmonids and non-salmonids alike. In addition, other mechanisms of effect are identified and discussed.

To conduct this consultation, NMFS deconstructed the proposed action and identified the appropriate activities to analyze for habitat effects. NMFS also identified the ongoing effects of other actions that are relevant to the analysis, but are not effects of the proposed action. Those effects, including those from past forestry practices (for example, the general depletion of sources of large woody debris, and sediment production from existing roads) are described in the environmental baseline. Thus, the environmental baseline is the summary of existing environmental conditions resulting from myriad factors, including prominent land uses, existing plans and ongoing projects, and certain Federal actions that had already undergone ESA section 7 consultation.

The environmental baseline also discusses factors affecting listed species would not be affected by implementation of the proposed action such as the effects of fishery harvest management, and generalized environmental factors such as ocean conditions and global climate change. Fishery harvest management involves multilayered complex agreements between multiple parties such as the states of Oregon and Washington, certain Indian Tribes, and the Federal government, all under continuing Federal Court oversight. The harvest management agreements are Federal actions for which NMFS consults on under ESA section 7, and prepares Biological Opinions. Information from those agreements, plans, and Biological Opinions is described in section 2.1.3.5 above. Similarly, the larger environmental issues (ocean conditions and climate change) were identified as factors affecting species addressed in this consultation, and were described briefly in section 2.1.3.6., above. However, while these factors "complete the picture" of factors affecting the covered species, the proposed action has no effect these factors. Therefore, the Biological Opinion does not analyze effects of the proposed action with respect to these issues. Instead, to the extent that future effects of these factors are reasonably certain to occur, they are discussed, albeit in brief, in the cumulative effects section, below.

To discuss the effects of timber harvest, NMFS developed a conservative overestimate of the amount of timber harvest that would occur across the covered lands, throughout the proposed term of the ITP. First, NMFS assumed the FPHCP activities will occur across the action area, throughout the 50-year term of the proposed ITP. It follows that the effects of the action will occur throughout and, in some beneficial instances, persist for some time beyond the 50-year ITP term. Since the analysis must describe the effects when they occur, the environmental baseline must capture conditions that will exist when activities are conducted throughout the permit term. Therefore, NMFS assumed (see section 2.1.4.1.2, below) that FPHCP harvest activities would occur throughout the ITP term, when stand conditions within each harvest unit reached a mid-seral condition (at about 50 years of age). This stand age represents an average typical of commercial forestry in Western Washington where forestry typically occurs on stands between 30 and 70 years of age. The average takes into account the fact that more harvest typically occurs in years of high market demand and less harvest occurs in years of low market demand. In fact, the actual harvest rate on the west side averaged between 1.0 and 1.3 percent between 1988 and 1993 (NMFS and USFWS 2005). On the east side, harvest rates averaged between 0.3 and 0.5 percent during the same period. Using the 50-year average, NMFS assumes that timber will be harvested at a rate of 2.0 percent of the covered lands if every piece of the covered land is harvested once during the ITP term. These rates indicate that if anything, the analysis used during this consultation assumes higher harvest rates than have occurred recently.

Since the timber harvest rate assumption is slightly more aggressive than past averages, the analysis is slightly more conservative, possibly overstating effects of harvest. Similarly, in Eastern Washington, commercial forestry is conducted according to un-even aged management, with far less clearcutting, making NMFS's assumption even more aggressive for the effects of harvest on the east side. Nevertheless, to project the condition of forest stands that would exist at the time harvest is conducted under the FPHCP prescriptions in the Environmental Baseline section above, NMFS generally described the conditions that would exist when harvest units reach a mid-seral condition.

For the effects analysis, NMFS focused the analysis on the relationships between the activities and the watershed processes they affect. The scope of the watershed processes examined is limited to those relevant to riparian and aquatic habitat including, water quality and quantity (especially temperature and sediment), physical habitat considerations (especially large woody debris, substrate, and channel characteristics), and food (especially primary productivity and leaf litter effects), among others. Thus, the environmental effects of the proposed action are the immediate and continuing outcome of conducting a forest practice, as governed by the FPHCP, on the watershed processes and functions that create and maintain the habitat of covered species in the action area.

The relationships between changes in habitat quantity, quality, and connectivity and the status and trends of fish and wildlife populations have been the subject of extensive scientific research and publication. General discussions of the relationship between changes in habitat variables and the status and trends of fish and wildlife populations are provided in Fiedler and Jain (1992), Gentry (1986), Gilpin and Soule (1986), Nicholson (1954), Odum (1971, 1989), and Soule (1986). Detailed discussions of the relationship between habitat variables and the status and trends of salmon populations are presented in FEMAT (1993), Gregory and Bisson (1997), Hicks et al. (1991), Murphy (1995), NRC (1996), Nehlsen et al. (1991), Spence et al. (1996), and Thomas et al. (1993), among others. NMFS has relied on the information in these publications in preparing this analysis, along with other information relevant to the effects of specific activities and processes on ecological conditions of particular areas and sites, as noted below.

Lisle (1999) defined five parameters of watershed function (water, woody debris, sediment, heat, and nutrients). The conditions of these parameters indicate freshwater and estuarine habitat conditions for salmonids and other fish. Focusing the analysis on these parameters for this consultation relies on the assumption that affected fish will experience demographic changes (that is, changes in vital rates, population size, and distribution) commensurate with the changes in these habitat-related variables as discussed below. 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 other suitable habitat. Nevertheless, given the broad geographic application of the forest practices in the FPHCP provisions, effects on habitat will likely occur throughout the action area, for the entire permit term, and for several years after the permit terminates. For the proposed action, the breadth and duration of habitat effects creates the potential for both population-wide effects on fish and watershed-wide effects on the PCEs of critical habitat. Therefore, these habitat-related variables are used to indicate any effects on population viability and on conservation value of critical habitat, as described below.

The effects analysis is organized around the five watershed parameters and the relevant activities affecting those parameters. For each parameter, the analysis consists of:

- A summary of how the parameter relates to habitat and covered species;

- A summary of the environmental baseline condition of the parameter at the time activities will be conducted (based on the assumptions stated below);

- A summary of the FPCHP activities that would influence the functional condition of the parameter;

- The reasonably likely change in the condition of the parameter from the activity and how that change relates to the creation and maintenance of aquatic habitat.

While the analysis focuses on habitat effects, some actions will affect habitat or animals in ways that are not readily captured within that framework. For example, worksite isolation using electrofishing designed to minimize effects on salmonids has the potential to wound or kill them. These effects are analyzed within the sections describing road construction and maintenance, and within the fine sediment inputs section since these effects occur during the construction and removal of road-stream crossings.

The next step of the effects analysis is to relate the environmental effects identified in the preceding step to the covered species and to the designated critical habitat. In focusing on the functions in watersheds that create and maintain riparian and aquatic habitat, NMFS assumed that, for time frames relevant to each given effect, individual covered fish would be present to experience the effects, creating exposure of those animals to the identified environmental effects. This is a conservative assumption as some of the effects will be either transitory or distant enough that exposure might not occur at all. Furthermore, in some instances, the FPHCP practice will be sufficient to avoid exposure. However, the scope of the FPHCP and proposed ITP are too large and enduring to derive precise exposure with any specificity. Therefore, NMFS cautiously assumed that covered species would be exposed, wherever the forest practices effects analyzed during this consultation occurred.

Having assumed that individual animals would be exposed to these habitat effects at the scale of individual FPHCP activities (sometimes referred to herein as the "operational unit" scale), NMFS must determine whether animal exposure to effects would cause animal responses to those effects. If species respond to environmental effects, then NMFS must determine whether those responses equate to increased risk of extinction of the affected covered species.

For salmonids, NMFS can conduct this analysis by first examining whether habitat effects in the action area will cause physical or behavioral responses in individual fish will adversely influence certain measures of viable populations including abundance, spatial structure, diversity, and productivity (McElhany et al., 2000). Since the action area for this consultation is far too large to provide a useful level of resolution for analysis of effects on individual animals, NMFS focused the analysis on the operational unit scale. For this consultation, the operational unit represents the size of an average individual harvest unit corresponding to a single Forest Practices Approval. For non-harvest activities (road maintenance, crossing, and abandonment activities), the operational unit represents a reach-length analysis. Using this scale of analysis, NMFS is able to determine the extent of effects on individual fish and assess whether, that extent has any bearing on the populations of fish exposed to those effects.

During consultation, critical reviewers insisted that the analysis underlying the consultation must include either population- or ESU-specific analyses to account for the specific habitat and life cycle needs of each covered ESU. NMFS takes this argument very seriously but believes that regardless of geography- or ESU-specific considerations, the biological requirements of all species addressed in this consultation are largely identical or similar enough, and that the effects of the activities prescribed by the proposed FPHCP would have the same effects on the processes that create and maintain habitat meeting the those biological requirements, no matter where those actions are carried out in the action area.

To this end, NMFS identified the biological requirements of the covered species in section 2.1.3.2 of the Environmental Baseline Section, above. As described in that section, the biological requirements for the covered salmonids, especially as they relate to the habitat effects of the proposed action, are the habitat characteristics that would support successful adult spawning, embryonic incubation, emergence, juvenile rearing, holding, migration and feeding in freshwater and the nearshore marine portions of the action area. Accordingly, the analysis starts with an examination of the effects of the action on certain watershed functional products (water, woody debris, sediment, heat, and nutrients) that contribute to creating and maintaining habitat that meets the biological requirements of affected covered species at the scale of any single operational unit that would be managed according to the FPHCP prescriptions, no matter where that unit is located in the action area.

The importance of this analytic structure is that it enables a determination of the proposed action's effects on fish at a comprehensible level of resolution, with enough clarity to enable logical conclusions at larger scales of analysis, including the effects of the action on the covered ESUs/ DPSs of salmonids. For example, for salmonids NMFS determined whether habitat effects at the operational unit scale on individual fish will adversely influence the measures of viable populations described above (McElhany et al., 2000). If effects on individual fish at the operational unit scale influence any of these measures of population viability, then NMFS must determine whether the effects on the affected populations will increase the species' risk of extinction. On the other hand, if the effects of the action do not impair the ability of habitat to meet the covered species biological requirements at the operational unit scale, if follows they would not adversely influence population viability, obviating the need for further analysis to support a "No Jeopardy" determination.

During consultation, NMFS also considered whether the application of this analytic framework could possibly foreclose the identification of those few places in the action area where the occurrence of even short term effects would be so significant to the affected population as to as to cause the jeopardy of the overall ESU/DPS. Specifically, stakeholders to the underlying process that led to the development of the FPHCP identified certain populations of covered salmonids that might demand a more specific analysis describing effects of the action on those populations. The problem as these stakeholders described it is the instance where short term adverse at the smallest scale of analysis (operational unit scale) could be severe enough to an effect on the local population or population subgroup these such that it would influence the likelihood of both the survival and recovery of the entire ESU of which that population was a part. To avoid missing any reasonably certain instance of this scenario in the analysis below, NMFS screened all of the covered listed salmonids to determine which might be vulnerable enough to fit the example. NMFS considered which ESUs or DPSs were population-limited such that effects to a single population might accrue increased significance for the entire ESU or DPS. The only ESU meeting this criteria is the Ozette Lake sockeye. In addition NMFS also considered certain populations specifically identified by the stakeholders' comments. The populations identified by the stakeholders included the White River spring, North Fork Nooksack, and South Fork Nooksack populations of Puget Sound Chinook (Bruce Davies, NMIFC, pers. comm.). This analysis appears in section 2.1.4.2.7, below.

Finally, in a separate step of the analysis, NMFS must determine whether habitat effects at the operational unit scale result in the destruction or adverse modification of critical habitat. To determine if the proposed action is likely to result in the destruction or adverse modification of designated critical habitat, the analysis focuses on the effects of the action on the PCEs of critical habitat. This analysis starts the same as the jeopardy analysis described above, with analysis of the expected response of habitat to operational unit scale effects. But rather than proceeding to examine the response of fish to those effects, the analysis continues in terms of the PCEs of critical habitat.

Presently, NMFS has no regulatory definition of the destruction or adverse modification of critical habitat. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat that was invalidated in litigation in August 2004. Instead, the analysis relies on the statutory provisions of the ESA that relate to critical habitat, and follows the general framework for critical habitat analysis recommended in guidance NMFS issued on November 7, 2005 (Appendix A). That guidance suggests assessing the condition of critical habitat in the action area, the factors responsible for that condition, and the conservation roles of the affected units of critical habitat. The guidance recommends relating the affected area to the entire designated critical habitat, and determining how effects of the action on PCEs of critical habitat in the action are will influence the function and conservation role of the affected habitat. The significance of any effects can be determined from information regarding the status of the entire designated critical habitat and its environmental baseline condition in the action area at the time effects occur.

Effects on conservation role are determined by examining effects on PCEs at the scale of individual forestry operations and relating those effects to the larger designation of critical habitat. Since many activities can take place within designated critical habitat without diminishing the value of constituent elements for the species' conservation, focusing on the effect of FPHCP practices at the local or operational unit scale is essential. Where the analysis determines that local effects on the PCE condition are unlikely to affect the conservation role of PCEs in the larger watershed, the analysis determines that that those operations will not adversely influence the conservation value of the affected PCEs, and the analysis concludes. On the other hand, where the conservation role of those PCEs is likely to be affected at the watershed scale, NMFS must determine the conservation role of that watershed in the larger designation of critical habitat. That relation can be accomplished by examining the CHART reports in which NMFS staff examined and rated the conservation value of every fifth field watershed included in the designation of critical habitat.

2.1.4.1.2 General Assumptions. To complete the steps described above, NMFS developed certain assumptions about FPHCP implementation that would inform the description of the environmental baseline and the effects analysis.

1) NMFS assumed that harvest activities of the type described in the FPHCP would be conducted according to the FPHCP provisions, and to the maximum extent allowed by the FPHCP and the Washington Forest Practices Rules. Although information is available that indicates some forest practices are typically conducted in a manner more conservative (protective of environmental factors) than would be allowed under the FPHCP, the assumption of "maximum extent" is based on the possibility that conditions may change as a result of market conditions, education, improved technology, lower operating costs, or changes in other constraining factors.

Furthermore, the analysis assumes that all FPHCP provisions will be implemented as prescribed in the FPHCP and the Implementation Agreement to the FPHCP. The ITP will include a condition regarding the monitoring and enforcement by the applicant of FPHCP compliance by operators regulated by the Washington Forest Practices Act. This enforcement condition, while not patent in the description of the proposed action is a commitment of the applicant based on the capacity the applicant already devotes to monitoring and enforcement under its ordinary regulatory charge. These existing commitments are recorded in, but not changed by the issuance the requested permit, and therefore have no relationship to the status quo for covered species. Therefore, they do not factor into the effects of the action.

2) Harvest activities contemplated by the FPHCP provisions would occur on covered land only after forests there reached a stand age and condition suitable for commercial harvest (mid-seral condition as described above). In western Washington, regeneration harvest typically occurs between 30 and 70 years stand age, based on an average harvest rate of between 1.0 and 1.3 percent of the land base harvested per year. According to this rate of harvest about one-half of the covered land base in the western Washington portion of the action area would be harvested over the 50-year term of the proposed ITP. However, to ensure the analysis in this consultation appropriately balances the risk of more aggressive harvest than past rates would indicate, NMFS assumed an average harvest stand age of 50 years. Since the proposed ITP would last for 50 years, this assumptions yields an analysis of the possibility that every harvestable acre of covered land would be harvested once during the proposed term of the ITP. Furthermore, NMFS knows that harvest rates and patterns in eastern Washington are even less aggressive than those in western Washington, as harvest typically occurs when stands exceed 50 years old, and then most harvest patterns are selective rather than clearcut. Again, the assumptions underlying this analysis provide a buffer against the risk that future harvest patterns and rates in eastern Washington will be more aggressive than past patterns and rates.

3) Since most forest in the action area is between zero and 50 years stand age (some acres are probably older), and inventory is distributed widely across the action area, harvest will occur at a steady rate and be well-dispersed across the action area. Even in the limited instance where NMFS has been apprised (based on present applications for forest practices) that local management activities have been intense and clustered, the practices under the FPHCP would

require application of the FPCHP prescriptions, the effects of which are described below. And based on the assumptions above, those recently managed units would not likely be subject to further forest practices until those units once again mature to a mid-seral stage.

4) Failure to identify features requiring buffers or avoidance (e.g., seeps, streams, and wetlands) will be rare. This assumption is based upon the fact that harvest units are generally visited numerous times in the assessment/cruising stage, harvest-unit layout, as well as during harvest unit review by landowners and managers, WDNR forest practices foresters, and others (e.g., interdisciplinary teams).

5) Failure to identify unstable features will be infrequent for smaller features and rare for larger features, and will generally be limited to situations where the risk of failure and consequences if failure occurs would both be low. This assumption is based upon the fact that the Washington Forest Practices Rules provide clear guidance on which features may be unstable, training is provided to foresters, and the State has additional procedures in place to screen applications and review them for potential instability. It is also expected that gradual improvement in identifying the recharge zones of deep-seated landslides within glacial deposits will continue.

6) While adaptive management is a prominent element of the FPHCP administrative framework and will result in improved conservation over time, NMFS cannot predict which aspects of the FPHCP may be modified through adaptive management in the future, nor anticipate the manner or degree to which these changes may occur. For those reasons, this Opinion analyzes only the existing prescriptions and requirements of the current Washington Forest Practices Rules and does not rely on Adaptive Management in reach the conclusions contained herein. Where certain practices are identified as the subject of adaptive management in the analysis below, NMFS is not indicating reliance on changes occurring to those practices through adaptive management as the basis for any of the determinations or conclusions made during consultation.

7) Road crossings will require major repair, replacement, or renewal at least once during the 50-year Permit term. This assumption is based upon the fact that the Permit term is longer than the average lifespan of road crossing structures.

8) The Services assume that Class IV Special forest practices applications, including SEPA review, will result in activities that are consistent with the biological goals and objectives of the FPHCP. This assumption is based upon the fact that, following SEPA review, WDNR may approve, deny, or approve an FPA with conditions. Those conditions can include minimization and mitigation measures. These measures are expected to achieve the biological goals and objectives of the FPHCP. In addition to SEPA policies that must be implemented, specific guidance is contained within the Washington Forest Practices Rules, such as WAC 222-10-030 (SEPA policies for potentially unstable slopes and landforms), which would further ensure these expectations.

9) No salvage will occur within buffers retained in 20-acre exempt parcels. This assumption is based on the fact that the Washington Forest Practices Rules addressing salvage require that stand-level requirements be met prior to salvage. Those stand-level requirements can only be met if the standard prescriptions were followed during timber harvest.

10) Alternate plans will be processed and approved as intended, with protection of the aquatic and riparian resources equal in overall effectiveness to the present Washington Forest Practices.

11) Other Assumptions:

- Chemicals will be used in some cases to control competing vegetation resulting from hardwood conversion and other timber harvest within the riparian zone before and after subsequent planting of conifers. This assumption is based on the fact that chemical use to control competing vegetation is a common practice especially where aggressive understory vegetation exists. Chemical use is not a covered activity, and use of some of these chemicals could injure or kill fish. Therefore, NMFS only analyzes the use of glyphosate (e.g., in the form of Rodeo®), with the least-toxic surfactants available (e.g., Agridex®). Glyphosate applied as anticipated is not likely to kill or injure fish.

  NMFS notes that: 1) forest managers will assess potential conversion sites carefully as successful planting with conifers would be extremely costly in areas that are likely to release significant amounts of shrubs; 2) foresters will promptly plant high-quality stock in converted areas; 3) riparian zones are narrow and therefore are not as difficult to address through manual non-chemical control; and 4) when chemical use is necessary, single or repeated use of glyphosate should be sufficient to address competing vegetation in conjunction with additional non-chemical control.

- Glyphosate will not be applied to typed waters. This assumption is based upon the fact that application of glyphosate directly to the aquatic environment is not addressed by the Washington Forest Practice Rules, even though Rodeo® and Agridex® are licensed for aquatic use. It is noted that hardwood conversions will be limited to areas farther than 30 feet (eastside) and 50 feet (westside) from such waters. Additionally, it is assumed that managers will maximize efficacy and minimize economic costs and therefore avoid costly spraying in areas and situations where the chemicals will be wasted. The FWS has no evidence of over-spraying with hand application.

- Failure to correctly identify fish-bearing waters will occur and is assumed to lessen over time. It is assumed that any methods used to map or delineate such waters will have an approximately equal probability of identifying waters as fish-bearing where fish do not actually occur or the reverse, identifying waters as non-fish-bearing where fish actually do occur. It is further assumed that such errors will be relatively small and largely offset at the landscape scale. This assumption is based upon the fact that this concept of equal error probabilities was inherent to the FPHCP.

- When Riparian Management Option 1 (thinning) is used for riparian harvest in western Washington, the stand-level requirement to retain 57 trees per acre within the inner zone will exceed the requirements for Desired Future Condition under the current basal area targets. This assumption is based upon preliminary calculations performed by the FWS, as well as information provided by Steve McConnell (Personal Communication, January 9, 2006) from sampling western Washington stands, that the 57 trees per acre was sufficient to meet or exceed the requirements of the Desired Future

Condition in 144 of 150 stands that were sampled.

2.1.4.1.2 Note on the Permit Condition Limiting the Effects of the 20-acre Exemption rule. During consultation, the effects of the 20-acre exemption rules remained controversial amongst the Forest and Fish Report caucuses. The rule was the subject of discussion during the April 21, 2006 Government to Government meeting, and in a subsequent meeting amongst the collaborators, caucuses, the association representing potentially eligible landowners on April 27, 2006. Related to the controversy, NMFS determined it did not possess sufficient information to complete an analysis of the effects of the rule, as it might be applied in the future for the 50-year ITP term. For the purpose of completing the analysis, both Services agreed to add a condition to their respective proposed ITPs that would foreclose the uncertainty. For purposes of this analysis, NMFS assumes that any ITP issued will contain the following conditions:

"Under the 20-acre exemption provision (FPHCP section 4b-3.1.3 [WAC 222-30-023(1) for western Washington] and FPHCP section 4b-3.2.3 [WAC 222-30023(2) for eastern Washington]), the Permit shall only apply to the following:

A. Forestlands owned by a person who affirms in writing on a forest practices application of qualifying as an eligible person under the "20-acre exemption" as of and since the date of Permit issuance.

B. Forestlands that are purchased, inherited, or otherwise lawfully obtained by a person who affirms in writing on a forest practices application of qualifying at the time that person takes possession of the forestlands under the following provisions:

1) The forestlands have continually been qualified for the "20-acre exemption" since the date of Permit issuance; or,

2) The forestlands have not been subject to commercial harvest under the jurisdiction of the Washington Forest Practices Act since the date of Permit issuance and are being converted to forestland from another land use.

C. Forestlands subject to a Class IV General Forest Practices Application only when the otherwise-qualifying applicant indicates on the application that he or she is not converting those forestlands to another use within three years.

D. Forestlands in any Watershed Administrative Unit (WAU) for which the permittee has previously established, with the review and approval by NMFS, an estimate of the length of streams on FPHCP Covered Lands. The Permittee shall establish, with review and approval of NMFS, a method to reasonably estimate post-harvest the length of classified streams on a 20-acre exempt site and the proportion of riparian function as measured by recruitable LWD from the site when compared to that which would have been provided under the standard riparian strategies. The Permittee shall monitor 20-acre exempt timber harvest activities and maintain a reasonable estimate of the cumulative change in riparian function provided by FPHCP Covered Lands as measured by recruitable LWD in each WAU that results from 20-acre exempt forest practices covered by this Permit.

1) The Permit shall not apply to forestlands subject to subsequent 20-acre exempt forest practices applications when the Permittee anticipates that forest practices on those forestlands will result in a cumulative reduction in riparian function as measured by recruitable LWD greater than 10 percent of what would have been provided in the WAU under the standard riparian strategies.

2) The Permit shall not apply to forestlands subject to subsequent 20-acre exempt forest practices applications in a WRIA once the WAUs within the WRIA exceeding the "10 percent limit" (above) represent more than 15 percent of the total stream length on FPHCP Covered Lands in the WRIA.

3) The Permit shall not apply to 20-acre exempt forestlands in any WAU where there is found the spawning and rearing habitat of bull trout populations identified in Table 3-51 of the U.S. Fish and Wildlife Service's (FWS) Biological Opinion until the Permittee has established, with review and approval of the FWS, that forest practices under the 20-acre exempt provisions will not measurably diminish the level of riparian function provided by FPHCP Covered Lands in the WAU as measured by recruitable LWD when compared to that which would have been provided under the standard riparian strategies.

2.1.4.2 Analysis

2.1.4.2.1 Effects of the Action on Hydrology. A review of the baseline for each WRIA shows that many Washington rivers have altered hydrology due to upstream dams and/or diversions. Specific information on these ongoing effects is provided in the *Environmental Baseline* section of this Opinion. In many of these rivers, dams have altered seasonal flow variations, resulting in reduced juvenile rearing habitat and increased mainstem temperatures. What is uncertain is the extent to which timber harvest and road construction have increased the magnitude of peak flows in smaller watersheds. In some study watersheds, the legacy of timber harvest and roads has been associated with a pulse of increased sediment delivery and deposition (Madej 1982, Swanson and Fredriksen 1982). Severe storms that trigger rain-on-snow events and road washouts occur about once every 10 to 20 years. Under the FPHCP and ITP, the influence of timber harvest and road management on hydrologic processes will gradually lessen as riparian buffers mature and RMAPs are implemented.

Timber harvesting activities can have significant effects on hydrologic processes that determine streamflow. While timber harvest alone typically has little effect on flows, indiscriminate road construction can alter runoff by collecting subsurface and road-surface water that routes directly to stream channels (Chamberlin et al., 1991, McIntosh et al., 1994). These road effects can increase peak flows during rainstorms (Ziemer 1998). Removal of substantial amounts of vegetation can be so great as to reduce evapotranspiration for several years following clearcutting, which can increase the amount of water that infiltrates the soil and ultimately reaches the stream. Therefore, streams draining recently logged areas can see increased summer base flows (Keppeler 1998, Lewis et al., 2001). Removing trees can also result in less delivery of water to streams. In one study, researchers found that about half the yearly water inputs to a higher elevation conifer forest came from fog-drip, i.e., cloud water that condenses on tree limbs (Lovett et al., 1982). Cutting trees in a coastal and mountainous fog-drip zone could remove a large fraction of annual water inputs. Another pathway of effects for altered hydrology is when a substantial area of forest ground cover is disturbed from felling and yarding, resulting in less infiltration and perhaps more surface flows. The magnitude and direction changes in base flows are site dependent (Thomas et al*.*, 1993).

The direct effects of substantially increased peak flows include stream channel alteration, bank erosion, redistribution of sediment and large organic debris, and flooding. Increased freshwater flows into estuaries may result in reduced penetration of the salt wedge upstream into the lower reaches of rivers (Allanson and Baird 1999, as cited in Levings and Northcote 2004).

The extent to which timber harvest alone has triggered substantially increased peak flows is unknown and likely rare (Storck et al., 1995). Rain-on-snow events generate large inputs of water to the soils, roads and streams. Concentrated flows from any source can exacerbate potentially unstable conditions on hillslopes by increasing the pore-water pressure, which decreases the strength of the soil (Sidle et al., 1985, as cited in NMFS and USFWS 2005); a reduction in soil strength increases the potential for shallow-rapid slope failure.

Soil compaction caused by heavy equipment and yarding can decrease infiltration capabilities, increasing surface runoff. Forest management activities that substantially disturb the soil, such as yarding, burning, or road and skid trail construction, can alter both surface and subsurface pathways that transport water to streams (Thomas et al*.*, 1993, Murphy 1995, Keppeler and Brown 1998). Logging can also alter the internal soil structure. 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 over a sizable area of steep slope, the flow can be routed to the surface and increase gully erosion and sediment delivery (Keppeler and Brown 1998). Disruption of subsurface flow could, potentially, affect freshwater seeps along the shorelines of estuaries and the marine nearshore. Inside Puget Sound, surf smelt spawning is thought to be associated with freshwater seepage, where the water keeps the spawning gravel moist (WDFW 2005). Disruption of these seeps could potentially cause reduced spawning success. Ditches associated with roads collect run-off and intercept subsurface flows and route them to streams more quickly. Unmanaged roads can act as first order streams and channel more water directly into larger streams (Whemple 1994). Peak flows can be so great as to have direct effects on salmon when 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). While a substantial increase in peak flows from timber harvest is possible, it is unlikely to be a common occurrence in any watershed. Fishes are more likely to be exposed to effects of altered inputs and routing of sediment and woody debris than exposed to speculative effects of altered flows.

FPHCP Measures Addressing Effects on Hydrologic Processes

This analysis assumes that timber harvest and other activities that have a low potential for causing hydrologic change will occur across the entire FPHCP landscape over the life of the FPHCP. Some areas might experience intensive activity over a short time period, but then experience a period of relatively little activity where the ecological processes take over and hydrologic effects decrease as vegetative recovery occurs.

Roads. The action area will experience a gradual reduction in road-source runoff over the life of the FPHCP as RMAPs are implemented. Landowners will be required to remove fish blockages, keep drainage structures functional, divert captured groundwater from ditchlines onto stable portions of the forest floor, maintain road surfaces to minimize erosion and delivery of water and sediment to typed waters, and slope or waterbar road surfaces to prevent water accumulation. Road decommissioning and stabilization will provide for a sizeable reduction in the number of road segments that deliver water to the channel network. The FPHCP lowers the potential for localized increases in peak flows associated with new road construction. Except for stream crossings, under the FPHCP, roads will be kept out of natural channels, CMZs, RMZs, Equipment Limitation Zones, and other sensitive sites, when there could be substantial damage to fish habitat. Considered here also are the effects of rock quarries and borrow pits, which function as roads. The effect of roads on hydrology are minimized by the proposed road construction and upgrading guidelines that call for hydrologically disconnecting much of the road network over the life of the FPHCP. Outlets of ditch relief culverts will be located to allow the dispersal of water to the forest floor before reaching any stream. Since much of the road network across FPHCP lands has been constructed, the effects of road-related peak-flow increases will diminish over the life of the FPHCP as roads are upgraded to FPHCP standards. In the long-term, effects of timber harvesting and road management on hydrologic processes will be negligible. The measures proposed in the FPHCP should provide for more rapid improvements given the emphasis on (1) identifying sensitive sites and requiring greater environmental review for new roads; (2) inventorying existing roads; (3) scheduling and upgrading roads to new standards prior to 2016; and (4) testing basic assumptions related to road rules through the adaptive management program.

Harvest Units. Timber harvest and associated site preparation activities influence hydrologic processes as discussed above. NMFS expects that some increases in peak flows and summer low flows will occur in subwatersheds that drain recently harvested areas, as would occur under any forest practices regimen. Effects of harvest on hydrologic processes will be greatest where harvest is concentrated in one sub-watershed over a relatively short time period and where harvest occurs in the rain-on-snow zone and when a rain-on-snow event occurs in the 15 to 20 years after harvest before the new trees grow to the point of providing a substantial measure of hydrologic maturity. Watershed Analysis, an unfunded part of the Washington Forest Practices Rules, addresses the effects of harvest on rain-on-snow generated peak flows. Although no new Watershed Analyses are anticipated in the near future, the results of about 50 completed Watershed Analyses suggest very little rain-on-snow peak flow impacts associated with timber harvest (NMFS and USFWS 2005). Given the resolution of the data, and the many variables that factor into peak flows (i.e., road connectivity, soil types, degree of ground disturbance), no specific response of peak flows to harvesting can be determined.

The Habitat Effects of Hydrologic Changes (Changes in Peak Flows)

Increases in peak flows can increase channel erosion in areas where individual harvest units might cumulatively encompass a large area of the subwatershed and roads intercept subsurface water. Where peak flows increase and the spatial pattern within a basin is synchronous or additive to peak flows downstream, channel erosion in lower-order channels could increase; resulting in an increased volume of sediment and perhaps woody debris transported to downstream fish-bearing reaches. In some watersheds, peak flow increases might be undetectable or asynchronous and not measurable downstream. However, to some degree this channel adjustment might have previously occurred during initial logging in the late 1800s and early 1900s and channels might already be enlarged to some degree to accommodate any increased peak flows with renewed harvest. Based on several studies in Washington (Coffin and Harr 1992, O'Connor and Harr 1994, Storck et al., 1995, and Bowling and Lettenmaier 1997), NMFS believes that peak flow increases might occur as a result of timber harvest but these increases are unlikely to cause premature scour of redds and therefore won't impair the watershed functions and processes.

The FPHCP's RMAP program will decrease the effects of roads on peak flows by reducing the extent of the road network that is hydrologically connected to the natural channel network. The RMAP program focuses on inventorying, identifying problem roads, and prioritizing work based on treating the worst problems first, on a watershed-scale. Therefore, new roads might cause localized, short-term (18 months or less) increases in peak flows and sediment delivery, but the net effect over longer time periods, across the action area, will be an overall decrease in road-related peak flow increases when other proposed measures (i.e., road upgrading and removal) are considered, with little, if any, detectable effect on redd stability and overall habitat conditions. Similarly, in estuarine habitats, there will be no detectable difference in the location of the estuarine salt wedge or area of maximum turbidity; nor will there be any effect to the covered species that use these areas.

Available information suggests that summer low flows might increase for a few years after timber harvest (Keppeler 1998) and this might provide minor improvements in habitat conditions (lower stream temperatures, increased instream wetted area, and volume) and increased aquatic productivity. However, if the proposed action does not change the rate of timber harvest relative to existing or recently past rates, the proposed action does not effect summer low flows (i.e., would not decrease summer low flows within a watershed in which harvest under the FPHCP occurs). Even if there are changes to the rate of timber harvest, any changes in summer flows would be so minor as to have undetectable effects on covered fishes or their habitats.

While the hydrologic regime is likely different than what historically occurred prior to any management in these watersheds, the effects of the proposed operations under the FPHCP are small and not limiting to populations of fishes in the action area. When added to baseline conditions, implementation of the Forest Practices Rules will result in slightly greater rates of recovery of hydrologic processes, given the greater emphasis on improving fish passage and passage of floods and wood through water-crossing structures; and on the repair of existing road faults and improvement in design of new roads. Localized impacts (for example, enlargement of receiving channels and increased sediment delivery) associated with peak flows can occur. However, channel expansion due to peak flows may have largely occurred during previous timber harvest and any future effects, including additional channel widening, will likely not be as extensive as that following previous harvests.

***2.1.4.2.2 Effects of Proposed Action on Large Woody Debris Supply*.** Many streams throughout the action area have either low in-stream woody debris loadings or low present recruitment potential from streamside forest stands due to past forest management practices and road development, or both. Past forest management practices often included streamside roads, splash dams and stream cleaning efforts. During the last century, splash dams were built to aid in floating and transporting harvested trees to the mill. From the 1950s through the 1970s, removal of LWD from streams was based on the belief that it was detrimental to salmon migration. Both practices, splash dams and stream cleaning, contributed to major changes in the amount of cover habitat available and often changed stream habitats to channels lacking woody debris. As stands in this baseline condition age toward the time of their next renegeration harvest under the FPHCP prescriptions, recruitment potential will increase as the result of second (or in some cases third) growth stands restock with trees beginning to meet criteria for functional LWD.

In-stream woody debris presence and recruitment potential are related to the extent of decay of instream wood and seral stage of current riparian vegetation. The most durable wood pieces in streams are large sizes of conifer heartwood; conifer sapwood and softwood are less durable. The largest sizes and most durable wood are from riparian forests upwards of 60 to 200 years old (Abbe and Montgomery 1996). Seral stage provides a general picture of riparian condition and quality, and potential LWD recruitment. In general, early seral stages produce riparian vegetation with lower riparian values (e.g., LWD) for aquatic biota. Mid-seral stands (those that would be harvested according to the FPHCP prescriptions) contain trees that function as LWD for creating and maintaining aquatic habitat. Finally, late seral stages (tree size greater than 24 inches in dbh) more fully provide LWD recruitment. Early seral (tree size less than 12 inches in dbh) hardwood riparian forests provide large amounts of high-quality detrital inputs of nitrogen-rich leaves. A Washington Forest Practices study (NMFS and USFWS 2005) concluded that unnaturally high levels of early seral stage vegetation existed on riparian zones on private forestland, primarily as a result of timber management activities. Approximately 78 percent of western Washington stream miles and 61 percent of eastern Washington stream miles flow through early seral stage riparian areas, while about 1 percent of western Washington miles and 5 percent of eastern Washington miles are late seral (NMFS and USFWS 2005). By the time these stands are ready for harvest under the FPHCP prescriptions, they will have attained mid-seral condition, providing trees recruitable for LWD.

Although present sources of recruitable LWD might currently provide functional habitat elements in small streams, existing riparian stands harvested under forest practices preceding the rules changes in 1999 and 2000 might not be of sufficient size and extent to maintain debris loadings as the existing instream load gradually decays or washes from the watershed. In the estuarine and nearshore marine areas, the historical amount of LWD was much greater than it is today (Gonor et al., 1988). Since the mid- to late-1880s, much of the large wood has been lost to human-related activities, including timber harvest and removal of LWD to establish and maintain safe navigation channels (Gonor et al., 1988).

The LWD enhancement has recently become a common method for improving LWD content in stream reaches and estuarine and marine shorelines lacking wood. LWD placement can provide benefits to these systems by providing bank stabilization, a more complex habitat structure, nutrient input, and substrate for invertebrate colonization, all of which would benefit fish habitat. These benefits are likely to improve current conditions in many areas until the natural riparian corridor can grow and provide inputs of LWD.

As stated above, NMFS assumes that harvest according to FPHCP prescriptions will occur when stands reach a mid-seral condition. Harvesting mid-seral stands according to the FPCHP riparian habitat prescriptions will retain recruitable sources of LWD at sizes that at least begin to provide the structural functions of LWD (summarized below) meeting the ecological needs of covered salmonids. The FPHCP prescriptions require RMZs of sufficient width and design such that trees retained after harvest would be at the very least begin to meet the size and proximity required to function as a source of recruitable LWD. Practices (e.g., no harvest in core zones or unstable slopes and basal area targets in the inner zone) under the FPHCP prescriptions will eventually increase the percentage of late-seral areas to 20 percent of covered lands on the westside of the State and nine percent on the eastside of the State. However, this recovery of woody debris supply and its consequent effects on habitat will take many decades, if not longer, as trees grow to sizes large enough to provide stable, functional pieces to adjacent stream channels. Expected beneficial changes in freshwater fish habitat include increased pool quality and quantity for juvenile rearing and adult holding, and a greater abundance of functional wood in smaller, non-fish bearing channels to ameliorate the effects of sediment inputs. Similarly, estuarine and marine habitats are expected to benefit from the increased input of woody debris. However, because much of the large wood entering the estuaries and marine water is removed by the U.S. Army COE to maintain safe navigation, the benefits of more LWD from freshwater riparian sources will be diminished in these habitats relative to the freshwater habitats.

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) and discussed, where relevant, in the description of the biological requirements of the non-salmonids species, above. Large pieces of wood delivered from hillslope sources, including blowdown of streamside and shoreline 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 might 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.

- *Organic substrate.* Woody debris in water is a substrate for invertebrates that contribute to ecological functioning, including prey base for fishes. Woody debris also contributes to the detrital food web in riverine, estuarine and marine habitats (Maser and Sedell 1994).

- *Stabilization of banks and beaches.* Trees that fall directly onto the bank and LWD that drifts on to the shoreline can provide protection for unstable and erodible banks and beaches. LWD also acts as a barrier to wind-transported sand and can form the nucleus for a temporary accumulation of sand (Gonor et al., 1988). Additionally, LWD can contribute moisture and nutrients necessary for the establishment of woody vegetation (Stembridge 1979, as cited in Gonor et al., 1988).

- *Spawning substrate*. Pacific herring may use woody debris for spawning substrate in estuaries and nearshore areas.

Each of these factors has been variously implicated as limiting habitat for many of the populations of covered salmonids considered in this consultation. Therefore, the manner in which the proposed action affects LWD has a bearing on the habitat risks faced by those salmonids. For example, Bishop and Morgan (1996) cited loss of pool habitat as an important habitat issue for the Nooksack populations of Puget Sound Chinook, among others. Similarly, beach siltation has been identified as a specific habitat issue for Ozette Lake sockeye. Therefore, the analysis below assesses the effects of the proposed action at the smallest possible geographic scale logical for this type of action: the effects of harvest in individual harvest units adjacent to affected waters, and of roads along individual stream reaches. This scale allows logical determinations to be made on the effects of the proposed action on populations of covered species using the waters at those places, and whether those population effects have any bearing on the long-term survival of the covered species.

FPHCP Measures Addressing Large Woody Debris Recruitment

The FPHCP prescribes several measures that will influence the supply of woody debris to streams. These measures include: (1) delineation of CMZs of certain widths and constraining activities in CMZs, (2) constraining activities and prescribing timber harvest within RMZs and requiring RMZs of certain widths, (3) identification and avoidance of mass wasting areas, and (4) prescribing road construction, maintenance, and abandonment, and rock quarries. Each of these proposed measures relative to woody debris recruitment is summarized below. To a large degree, past activities have reduced the inputs of woody debris to streams by the harvest of forest stands in riparian and unstable landform areas, the construction of roads, and the removal of wood from channels (as discussed in the *Environmental Baseline* section). Much of the analysis of effects here is focused on how the proposed action will allow for long-term (40 or more years) recovery of natural wood recruitment processes.

No timber harvest, road construction or salvage is permitted within CMZs except for the construction and maintenance of road crossings and the creation and use of yarding corridors in accordance with applicable rules. Section 2 of the Forest Practices Board Manual (Board Manual) describes how to identify CMZs and bankfull channel features. Across the action area, most streams have narrow or no CMZs, which occur primarily along the lower portions of larger channels where channels are more likely to flow through unconfined valleys. For streams that show evidence of migration as described in the Board Manual, the RMZ begins at the outer edge of the CMZ. For streams without a CMZ, the RMZ begins at the outer edge of the bankfull width.

Channel migration might occur gradually, through progressive bank erosion, or more abruptly by channel avulsion, where the channel abruptly shifts position during a high flow event (O'Connor and Watson 1998). Predicting when and where these processes are likely to occur can be difficult, particularly in the case of channel avulsion. Regardless of whether channel migration occurs abruptly or gradually, the FPHCP prescription address channel migration by placing the RMZ on the outside of the CMZ.

Where CMZs are appropriately delineated to encompass the entire range of potential channel migration over time periods of sufficient length to allow trees to attain sufficient size to function in the channel (i.e., decades to hundreds of years for larger channels), the CMZ prescription will provide for relatively unimpaired recruitment of woody debris from channel migration and associated bank erosion. Less potential wood recruitment could occur in the unlikely situation where a channel migrates through an area inappropriately delineated and that has experienced extensive timber harvest. Given the suspected infrequency of CMZs across the FPHCP landscape, coupled with the CMZ study in the adaptive management program, inaccurate identification of CMZs over the term of the FPHCP might result in only isolated instances where covered fish species habitat is adversely affected due to lack of larger woody debris recruitment from CMZs.

As discussed in the *Description of the Proposed Action* section, the FPHCP's Riparian Strategy recognizes that in-stream woody debris and perpetual LWD recruitment is important for creating, restoring, and maintaining aquatic and riparian habitats. The strategy protects these and other functions along typed waters by restricting forest practices activities from the most sensitive parts of riparian areas and by limiting activities in other areas. RMZ protection measure requirements are described in the FPHCP (Chapter 4b-3), EIS (Chapter 4.7), Forest Practices Board Manual (Section 7), and applicable WAC chapter.

Riparian management zones (RMZs) and equipment limitation zones (ELZs) are the primary riparian protection measures for typed waters. RMZs are areas adjacent to Type S, Type F, and Type Np waters where trees are retained so that ecological functions such as LWD recruitment are maintained. An ELZ is an area where equipment use is limited in order to minimize ground and soil disturbance and thus protect stream bank integrity and prevent sediment delivery to non-fish-bearing waters. ELZs apply to all Type Np and Type Ns waters, are 30 feet wide, and are measured from the bankfull width. Other riparian protection measures that apply to typed waters include restrictions on the salvage of down woody debris and the disturbance of stream banks.

Log Placement. Occasionally riparian restoration in the form of placement of large woody debris will be proposed as part of a timber harvest. In-stream log placement can occur in two ways: (1) Equipment is used to place the bole with attached root wad into the stream and/or (2) the bole is adequately secured to the bank or bed. Placement of a bole without an attached root-wad will generally require other methods to secure the piece within the stream. While large wood placement in streams is generally done to benefit the aquatic system as well as the fish species which depend upon those habitats, instream work might injure or kill fish present in the construction footprint. Work using heavy equipment can take one or more days and might result in some soil exposure. It is expected that such placement activities would occur only once per rotation. Power tools and heavy equipment would be used in log placement.

Shade Requirements. In addition to meeting the riparian management zone requirements for Type S and Type F waters, landowners must satisfy shade requirements to maintain water temperature. Shade requirements must be met regardless of harvest opportunities that might exist under the RMZ inner zone rules. Trees left to meet the shade requirement will be available in the future as recruitable LWD. Shade requirements differ for forestlands within the bull trout overlay (BTO) and lands outside the BTO. The BTO includes portions of eastern Washington streams containing bull trout habitat as identified on the WDFW bull trout map. RMZs for Type S and Type F waters on exempt 20-acre parcels must also meet shade requirements. However, the RMZs for Type S and Type F waters on exempt 20-acre parcels begin at the outer edge of the bankfull width, regardless of the presence of a CMZ.

Salvage Logging. Removal of down wood in streams, rivers, and riparian areas reduces the quality and quantity of habitat available for many covered species. FPHCP prescriptions would protect ecological functions and associated habitats by restricting the salvage of down wood in typed waters, channel migration zones, and riparian management zones. Salvage logging is not allowed within the bankfull width of any typed water or within a channel migration zone, including salvage logging of any portion of a tree that might have fallen outside the zone. Salvage logging within an RMZ for a Type S or Type F water is based on the sub-zone (core, inner, and outer zones) from which the tree originated, applicable stand requirements and extent of previous harvest activity in the zone. Salvage logging is not allowed within an RMZ for a Type Np water or associated sensitive site, but might occur adjacent to Type Ns waters.

Streambank Integrity. The margins or banks of streams, estuaries, marine waters, and river channels provide important habitats for both aquatic and riparian-dependent species. Forest practices that cut streambank trees or result in areas of exposed streambank soil would adversely affect these habitats by altering the character of stream banks and perhaps diminishing LWD recruitment.

Forest practices prescriptions in the FPHCP require that activities in the RMZ core zone for Type S and Type F waters and in RMZs for Type Np waters must ensure stream bank integrity is maintained. Activities must avoid disturbing stumps, root systems and any logs embedded in the stream bank. Where necessary, high stumps near the streambank must be left to prevent felled and bucked timber from entering the water. Trees with large root systems embedded in the stream bank must also be left. In addition to these requirements, activities that affect stream bank integrity such as road construction or log yarding might require an HPA permit from WDFW. Activities that require an HPA are subject to additional conditions under the state's Hydraulic Code (see, WAC 220-110-030(17)). Therefore, any effects to streambank integrity are likely negligible.

Exempt 20-acre parcels. Under the State's Forest Practices Rules, "small" forest landowner parcels include those that are 20 contiguous acres or less and are owned by individuals whose ownership is less than 80 forested acres statewide. These parcels are commonly referred to as "exempt 20-acre parcels." While not subject to some standard riparian requirements (i.e., those required on non-exempt parcels), exempt 20-acre parcels must still provide protection for public resources in accordance with the state's Forests Practices Act. Like standard measures, public resource protection on exempt parcels occurs through the establishment of RMZs for Type S and Type F waters.

The FPHCP has minimum buffer width and leave-tree requirements for Type S and F waters on exempt 20-acre parcels. Buffers would be retained according to pre-2000 rules plus 15 percent of the volume. In addition, shade requirements must still be met on type F and S streams. For 20-acre exempt parcels, buffers on type F and S streams are measured from the bankfull width (as opposed to the outside of the channel migration zone). The required ratio of conifer to deciduous leave trees, and the number and minimum diameters of leave trees, varies with water type and bankfull width. Generally, the regulatory requirements of the 20-acre exemption (in the absence of the shade rule) could be met with retention of about 20 trees per acre dispersed within the first 50 feet of the stream, or clumped retention on less than 1 percent of the buffered area. Under the 20-acre exemption, yarding in riparian areas will occur closer to the stream than under standard rules. NMFS assumes there would be no salvage of wind thrown trees from buffers.

For fish bearing streams on these ownerships, shade would be met through forest practices. However, LWD recruitment would not occur at the same rate as under standard rules because of the combination of reduced buffer width, density, and point of measurement.

Trees will be required to be retained along Type Np streams only where such practices are necessary to protect public resources. Where such leave-tree practices are necessary, at least 29 conifer or deciduous trees, 6 inches in diameter or larger will be retained within 29 feet of the stream on each side of the stream for every 1,000 feet of stream length. The leave trees might be arranged to accommodate timber harvest operations. This could be accommodated by leaving about 44 trees per acre dispersed, or by retaining a tenth-acre patch (300 trees per acre) unharvested for each 1,000 foot reach (about two-thirds of an acre). However, because such buffers are seldom required outside of municipal watersheds or other rare situations, generally no buffer will be required on Np streams on 20-acre exempt parcels. The 20-acre exemption does not require that the shade rule be met on streams without fishes. The extent to which fishes could be exposed to biologically meaningful conditions in these 20-acre areas is unknown.

Alternate Plans. Harvest under Alternate Plans can occur in a modified manner according to individual or grouped alternate plans. One example of an alternate plan is the overstocked-stand template for non-industrial landowners. A core zone of 14 to 30 feet (equal to a crown radius) would be retained and large wood placement would occur. Stand density controls would be applied outside the core zone according to tree size.

Management of overstocked stands is expected to have long-term benefits by reducing competition among trees, speeding growth of standing trees, and improving the health of the remaining stand. Trees that would have succumbed to suppression mortality will be removed;

however, it is expected that few of these trees would have fallen into the stream or provided meaningful value to the stream or riparian area. Smaller suppressed trees are less likely to provide key piece size and they are more likely to rot in place (rather than falling intact) while being held up by branches of surrounding trees. Larger trees developed over time through management are expected to provide more function to stream and riparian areas when they eventually fall. Understory vegetation will often respond and re-establish itself in a short period of time.

Roads and Large Woody Debris. Compared to prior iterations of the forest practices rules, the current rules related to road construction, maintenance and abandonment have changed little. For the most part, FPHCP prescriptions emphasize improvements in stream-crossings, sediment reduction BMPs, and hydrologic connectivity. Very little difference is expected to result from these changes regarding the number and location of roads upon the affected landscapes.

The rules under the FPHCP direct landowners to fit their roads to the topography so that a minimum of alterations to the natural features will occur. Except for crossings, new stream-adjacent parallel roads will not be located within natural drainage channels, channel migration zones, sensitive sites, equipment limitation zones, and riparian management zones when there would be substantial loss of, or damage to fish habitat unless other alternatives will cause greater damage to public resources. These rules are expected to provide additional protection to sensitive sites throughout the action area.

The space a road occupies within an area that can contribute wood to a watercourse decreases the overall supply of wood available from that space. Although construction of new stream-adjacent parallel roads will be severely restricted under the FPHCP, a legacy of lost LWD recruitment opportunity is likely to persist from existing roads. Similarly, under current practices (i.e., those proposed in the FPHCP), steep slopes will be avoided when constructing new roads. However, past road construction did not always preferentially avoid these locations and the present road network reflects this.

The Effects of the FPHCP on Large Woody Debris Recruitment Processes

As previously harvested stands mature to mid-seral conditions and become ready for timber harvest, they will begin to contain trees recruitable as functional LWD. Harvest according to the prescriptions of the FPHCP will protect the existing level of function at the time of harvest and enable an even greater level of functional LWD recruitment as trees in the core and inner zones of Type S and F RMZs without roads mature further in the years following harvest. Limiting harvest in the RMZs (no-harvest in the core zone and basal area targets of the inner zone), will provide for substantial recruitment of woody debris to channels through the natural processes that drop trees into streams (bank erosion and suppression mortality). Existing roads in the riparian zone reduce or even eliminate sources of recruitable LWD within within the footprint of the road. This effect will be most pronounced where roads parallel streams and the delivery of wood from upslope of the road is restricted in addition to the footprint of the road itself. This result will be greatest in Type S streams where roads have been constructed through the wider valleys developed by these larger watercourses.

Windthrow of trees in the RMZs also naturally recruits them to streams where they function as LWD. Harvest within the RMZ can affect the wind-firmness of remaining trees. Windthrow rates in Washington and Oregon are variable and have been reported to average 5 percent (Mobbs and Jones 1995; Hobbs and Hallbach 1981, as cited in Grizzel and Wolff, 1998), 10 percent (TFW 1994), 12 percent (Sherwood 1993), 22 percent (Andrus and Froehlich 1988), and 29 percent (Steinblums 1978). Generally, thinning decreases risk of windthrow of trees within the riparian buffer, while adjacent clearcut in some sites increases the windthrow risk. RMZ leave tree requirements were increased to offset increased windthrow risk. Grizzel and Wolff (1998) studied buffer strips on small streams in northwestern Washington and reported that about 33 percent of buffer trees were affected by windthrow. However, only 3 of 40 sites had more than two-thirds of the trees windthrown. In most cases, it is expected that the integrity of the buffer will be maintained, even if some windthrow occurs.

The 20-acre exemption rule could result in less protective RMZs, and a reduction in available functional LWD. Operations under the 20-acre exemption might not provide LWD from Type Np and Type Ns channels that would otherwise be provided under the FPHCP prescriptions, unless restoring LWD recruitment is part of the landowner's stewardship plan and goals for the property. However, the reduction in LWD recruitment from non-fish bearing streams on these small ownerships will be minor as only 0.5 percent to 5 percent of FPHCP lands are eligible for the 20-acre exempt status, and there are far fewer Type N stream miles on 20-acre exempt parcels than they are on the other FPHCP lands because of their position on the landscape. Possible effects on LWD recruitment and covered species and their habitat are further minimized because selective harvest within the RMZs on 20-acre exempt parcels rarely occurs, even though it is allowed under the forest practices rules. A recent survey revealed that most small landowners do not harvest within the RMZs of their 20-acre exempt parcels (Personal Communication, Sue Casey and Bob Anderson, Washington DNR, July 2005).

The proposed ITP limits application of the 20-acre exemption provisions to certain parcels that presently qualify as exempt and have therefore been "grandfathered" for purposes of this analysis (see section 2.1.4.1.2, above). Grandfathering eliminates the possibility of any fracturing of larger ownerships for purposes of gaining application of the 20-acre exemption provision of the Forest Practices Act, enhancing the certainty of this analysis. The ITP conditions shown in section 2.1.4.1.2 above further limit application of the 20-acre exempt provisions by mandating WAU by WAU thresholds for allowable functional diminution relative to the standard FPHCP riparian prescriptions and requiring the applicant implement a process to monitor such Forest Practices Applications by eligible 20-acre parcel owners to ensure those thresholds are never exceeded. As a result of those limitations, there will never be any WRIA in which the difference between full application of the standard riparian prescriptions and the exempt prescriptions will exceed 9.1 percent less than full function.

While placement of wood with attached root-wads will provide better stability of large wood, in some steep stream channels the wood can move downstream, with attendant effects lower in the stream system. This potential for movement is especially true for large wood placed without an attached root wad. Large wood that remains in place is expected to alter the dynamics between predatory and prey fishes, alter local sediment deposition and result in temporary storage of that sediment, and act as a host site for aquatic invertebrates. Generally, adding wood is an ecological benefit (Dominguez and Cedarholm 2000).

Hardwood conversion activities can affect LWD recruitment. In the short-term (between zero and 10 years), a conversion from a hardwood-dominated riparian area to one dominated by conifers might remove some recruitable, but less desirable hardwood LWD. This loss of large woody debris will take decades to replace as conifer replacement matures to recruitable pieces, but in the long-term (greater than 40 years from conversion activities), there will be far greater sources of conifers, eventually providing durable large woody debris exceeding any function that would have accrued from hardwood recruitment.

When timber-stand-improvement activities are conducted in unbuffered areas within the RMZ, a slight reduction in future LWD might result. However, these effects are expected to be minor in comparison to regeneration harvests (e.g., clear-cutting). Timber stand improvement will generally only remove small trees that are too small to have economic or ecological value.

An effect of road construction is the creation of road corridors which influence the recruitment of LWD. When roads are constructed within or across riparian areas, trees are removed, some of which might otherwise become LWD. Roads can also prevent fallen upslope trees from reaching the stream. Removing trees from road corridors within the riparian zone can increase windthrow concerns for remaining trees. However, under the FPHCP, new road construction on or within riparian areas is generally prohibited except were necessary for stream crossings.

New and existing stream crossing structures can potentially reduce the capacity for in-stream LWD transport by restricting the natural channel and floodplain width. The current (FPHCP) prescriptions will be better than previous rules at protecting against such failures. FPHCP construction standards are expected to improve passage for fishes, allowing new or improved habitat access. The road crossing standards will also provide better transport of water and large wood than under previous regulations.

Timber harvest to prepare for road construction may occur on unstable slopes in the unlikely situation that site investigations fail to identify unstable slopes and features. This harvest might reduce the amount of recruitable wood available when the unstable slopes fail. Failure to identify such areas is expected to be rare.

Summary of Effects on Large Woody Debris Recruitment and Delivery

In-stream LWD sources in previously logged operational units will remain low (and even decrease as the result of hardwood to conifer conversion activities) until those stands once again attain mid-seral age and characteristics. Existing LWD in streams that would be supplied by those adjacent operational units will decline naturally through decay and fluvial transport. These decreases are a function of the condition of the environmental baseline, not the effects of the action (except in the case of hardwood conversion). Roads will continue to have a pervasive effect on woody debris recruitment, particularly where roads parallel streams. However, in the long term (greater than 40 years from when the unit was previously harvested), riparian stand targets that approach mature forest stand characteristics will provide widespread sources of woody debris function in the action area due to tree growth and retention of a substantial number of trees in the RMZ along fish-bearing streams.

Some LWD in fish-bearing streams is transported downstream from non-fish-bearing streams, and timber harvest allowed under the riparian prescriptions on Type Np and Type Ns streams will limit increases in LWD supplied to fish-bearing streams over the long term (greater than 10 years). On portions of Type Np streams, RMZs will be at least 50 feet wide, which might create a greater potential for windthrow. Also, harvest will be allowed to the streambank on Type Ns and all other Type Np streams. Therefore, although site conditions can require retained riparian trees, there will be no assurance of direct protection of LWD recruitment potential.

According to results from the Equivalent Buffer Area Index (EBAI) model (NMFS and USFWS 2005), Type Np streams will provide between 38 and 51 percent of the full LWD recruitment available under an essentially no-harvest scenario in an RMZ with a width of a site potential tree height. For type Ns streams, the EBAI predicts that less than 20 percent of the full LWD recruitment would be available. Marine and estuarine areas that receive discharge directly from non-fish-bearing streams will receive less wood than would be available to fish-bearing streams downstream of Type Np and Ns streams, as the LWD is likely to be retained in the river system.

Although the model predicts less recruitable wood from non-fish-bearing stream RMZs, sufficient LWD for occupied habitat would be available because the FPHCP prescribes protection of the unstable landforms that are the primary sources of LWD. For example, many Np and Ns stream segments flow within steep, confined channels that would have adjacent steep banks protected as unstable slopes.

The overall, cumulative effect of woody debris considerations is discussed in the *Integration and Synthesis* section where the role of sediment, wood and water is collectively analyzed.

2.1.4.2.3 Effects of Proposed Action on Chronic Sedimentation and Turbidity. A review of the environmental baseline for each WRIA suggests that nearly all areas suffer from high loads of coarse and fine sediment from past activities. Many of the streams in the action area have been listed under the Federal Clean Water Act as impaired due to sediment and/or turbidity. However, as forest practices have improved in the past few decades, and especially since the adoption of the current Forests and Fish Rules by 2000, conditions related to chronic sedimentation and turbidity have improved. Most of the improvements have come from measures designed to minimize the generation and delivery of fine sediment from road maintenance and abandonment activities and timber harvest activities.

Baseline chronic sedimentation processes will continue to improve as excessive sediment loadings from past and historical practices and requirements are gradually eliminated and the natural long-term equilibrium between sediment inputs and outputs is restored. Like the development of LWD sources under baseline conditions, some of the improvement in sediment processes can be attributed to the development and maturing of previously harvested stands. Sites with impaired spawning substrate quality would improve, thereby favoring increased juvenile emergence rates. Also, pool volumes would increase due to the export of excess fine sediment, improving conditions for juvenile rearing and holding.

When added to trends in the environmental baseline attributable to forest growth following previous harvest, the FPHCP prescribes forest practices rules related to the placement of fill and water-crossings, road maintenance, and fish passage requirements. The prescribed practices will contribute to reducing existing sediment delivery. In particular, critical questions such as those related to sediment delivery performance targets and the effectiveness of forest practices rules in meeting those targets will have a higher likelihood of being addressed under the FPHCP.

Chronic sediment delivery (especially fine sediment) has several different results for covered fish and their food sources. The following discussion on the effects of chronic sedimentation and turbidity is based on a comprehensive summary by Spence et al., (1996), unless otherwise cited.

Chronic siltation of streambeds can reduce the diversity and densities of aquatic macroinvertebrates used as a food source by covered fish species. Turbidity can adversely affect fishes at every stage of their life cycle. Auld and Schubel (1978) found that larval survival in American shad (*Alossa sappidissima)*, a clupeid fish, was reduced under conditions of elevated suspended sediment, but hatching was not. 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 covered fish species. When turbidity levels are persistently elevated, juvenile growth rates might be suppressed due to the poor feeding conditions.

In estuarine and marine waters, substrate grain-size has been shown to be a determining factor in habitat selection by a variety of species that are either covered by the FPHCP, or are similar to those that are covered (Becker 1988; Howell et al., 1999; McConnaughey and Smith 2000; Stein et al., 2004). Storm-induced siltation of a previously-sandy lagoon in California has been blamed for the significant reduction in numbers of shiner surfperch (Onuf and Quamment 1983). Spawning habitat for surfsmelt and sandlance is particularly vulnerable. These species utilize sandy/gravelly upper intertidal beaches for spawning (Pentilla 1997) and could be susceptible to degradation should large amounts of fine sediment be delivered to these beaches. Similarly, Ozette Lake sockeye, an ESU comprised of multiple (but few) spawning populations, are beach spawners with habitat limitations caused by beach siltation at various places in Ozette Lake (Good et al.,2005). Therefore, as stated in the preceding section analyzing effects on LWD, the manner in which the proposed action affects sediment processes has a bearing on the habitat risks faced by these covered species. Accordingly, the analysis below assesses the effects of the proposed action at the smallest possible geographic scale logical for this type of action: the effects of harvest in individual harvest units adjacent to affected waters, and of roads along individual stream reaches. This scale allows logical determinations to be made on the effects of the proposed action on populations of covered species using the waters at those places, and whether those population effects have any bearing on the long-term survival of the covered species.

Proposed FPHCP Measures Influencing Sediment Delivery

The *Description of the Proposed Action* section (above) describes several methods landowners will use to minimize the generation and delivery of fine sediments from timber harvest operational units to stream channels. In general, these measures focus on equipment operating restrictions, and riparian and silvicultural prescriptions for leaving standing trees and other vegetation after harvest. Issues related specifically to roads and sediment are discussed in a separate section below.

Fish-Bearing Streams (Type F and Type S watercourses). Along streams with fishes (Type F or Type S streams), buffers will be applied as directed by the FPHCP. Within the buffers, tree removal will occur consistent with the guidelines in the FPHCP and as dictated by current stand conditions and the Desired Future Condition. No harvest of trees would occur in the 50-foot Core Zone (nearest the stream). Harvest within the Inner Zone (between the Core Zone and the Outer Zone) must be consistent with the stand requirements to achieve Desired Future Condition. The Inner Zone width varies depending on a number of factors. Outer Zone widths also vary as do requirements for retention. Generally, within the Outer Zone, at least 20 conifer trees per acre that are 12 inches or more in diameter must be retained in a dispersed or clumped manner; but, exceptions exist for situations where large wood placement will occur or where special features require buffering.

No timber harvest is expected within the Core Zone. Only under certain circumstances (e.g., yarding corridors where trees might interfere with lowering and raising of cables or might fall upon cables) may trees be felled and then they must be retained on site. Timber harvest within the Inner Zone (managed for Desired Future Condition) will result in minor levels of tree removal. In both cases, some tree removal might result in temporary openings in the canopy, at a localized level.

Timber harvest measures within the RMZs would minimize ground disturbance, thus allowing natural roughness elements and intact duff on the forest floor to capture most of the fine sediment generated and delivered from upslope areas. These measures include restricting ground-based equipment use within the bankfull width of Type S and Type F waters, limiting equipment use along Type Np and Type Ns waters, and prohibiting the removal of downed wood within the bankfull width of typed streams. Equipment-use restrictions include the type, timing, and location of equipment use in and near waters and riparian management zones. Movement of heavy equipment within the riparian zones will be limited and will not generally occur within the Core Zone. Such equipment will generally operate on top of logging slash and downed vegetation to further minimize soil disturbance.

Best Management Practices include the use of low-impact harvest systems in wet soil conditions, leading-end log suspension during yarding operations, minimizing damage to residual vegetation, and limiting the number and frequency of yarding corridors. Established skid trails will be used to avoid equipment travel where soil compaction is an issue, and skid trails will be decommissioned upon the completion of operations. Only a very small amount of felling and bucking is expected to occur within riparian buffers of fish bearing streams, and as such, the need for equipment to penetrate these areas will be very limited. Felled trees within the core zone will be left and few trees are expected to be removed from the inner zone. Generally, directional felling will be used and which locates bucking and other activities away from the stream. These requirements are all intended to protect the structure and function of forest soils, thereby minimizing the risk of accelerated erosion and sediment delivery associated with forest practices activities.

On some 20-acre parcels (as defined above), buffers must be retained according to pre-1999 emergency rules, plus 15 percent of the tree basal volume. This prescription requires more retained vegetation in riparian areas than in the pre-1999 rules, leading to at least slightly higher functional condition after harvest. In addition, shade requirements must still be met on Type F and Type S streams. Buffers on Type F and Type S streams are measured from the bankfull width for 20-acre exempt parcels (as opposed to the outside of the channel migration zone for standard rules). Under the 20-acre exemption, yarding in riparian areas will sometimes occur slightly closer to a stream than under standard rules.

Alternate Plans for timber harvest along fish-bearing streams will be written to address situations where some land owners develop different harvest regimes based on site-specific conditions. The FPHCP requires these landowners to ensure that riparian and aquatic functions are equivalent or better than levels achieved under the standard FPHCP prescriptions. Over time, an increasing number of landowners could use this tool, leading to the development of operational templates suiting a variety of site-specific conditions. While the early site-specificity of operations under the Alternate Plans concept makes the design of those operations difficult if not impossible to predict, the development of templates will lead to more broadly predictable results relative to the desired future functional outcomes of those operations. Despite the difficulty in predicting the outcomes of early Alternate Plans, this analysis assumes that the requirement of at least functional equivalency, if not exceedances, will lead to the same or greater ecological protection than would occur under the standard FPHCP prescriptions. Therefore, it is expected that the impacts on the aquatic and riparian environment will be essentially the same or less than what would occur under the standard rules.

Harvest under Alternate Plans may occur in a modified manner according to individual or grouped alternate plans. One existing example of an Alternate Plan is the overstocked-stand template for non-industrial landowners. A core zone of 14 to 30 feet (equal to a crown radius) will be retained and large wood will be placed in streams. Stand density controls will be applied outside the core zone according to tree size.

Non-fish Bearing Streams (Type Np and Type Ns). Harvest may occur along unbuffered reaches of perennial streams without fishes (Type Np), along buffered reaches of Type Np streams (outside the 50-foot no-harvest Core Zone), or along seasonal streams without fishes (Type Ns). The required buffers on Type F and Type S streams will likely restrict harvest within 100-feet, or more, of Type Np or Type Ns streams at points of confluence with Type F and Type S streams.

In general, at least 50 percent of the Type Np stream length will be buffered with a 50-foot buffer. For streams less than 1,000 feet in total length, the lower 300- to 500-foot reach can be the buffered portion of the stream. Upstream of the 300- to 500-foot lower reaches, a variable percentage of the stream can be buffered. The regulations guide the percentage of stream buffered and the placement of the buffered reaches.

For Type Ns streams, any buffering required will be provided through prescriptions to address slope instability or other resources. On steep and unstable landforms, up to 50 percent of the seasonal streams without fishes will receive a convergent headwall or inner gorge classification and receive buffers accordingly. On other landscapes, Type Ns streams might not be buffered. In all cases, a 30-foot equipment-exclusion zone would be maintained.

Felling and bucking in riparian areas along seasonal streams and unbuffered segments of perennial streams may occur close to the stream. Directional felling would increase the distance from the stream where most bucking activities would occur. Felling and bucking adjacent to buffers on Type Np streams would occur outside of and at some distance from the 50-foot buffer due to the use of directional felling.

Timber harvest may occur on unidentified unstable slopes (e.g., convergent headwalls and inner gorges) within the RMZ of non-fish-bearing streams in the unlikely event that site investigations fail to identify unstable slopes and features or when incorrect prescriptions are applied to identified areas. Timber harvest on a potentially unstable slope might exacerbate slope failure and might result in delivery to aquatic resources. Failure to identify such areas is expected to be rare.

On 20-acre exempt parcels, trees will be required to be retained along type Np streams only where such practices are necessary to protect public resources. This public resource protection standard is seldom invoked, except for municipal watersheds and other rare situations. When it is, at least 29 conifer or deciduous trees, 6 inches in diameter or larger will be retained within 29 feet of the stream on each side of the stream for every 1,000 feet of stream length. The leave trees may be arranged to accommodate operation. This could be accommodated by leaving about 44 trees per acre dispersed, or by retaining a tenth-acre patch (300 trees per acre) unharvested for each 1,000 foot reach (about two-thirds of an acre). When the public resource protection standard is not invoked, generally no buffer will be required on Np streams on 20-acre exempt parcels. The shade rule is not required on the non-fish-bearing streams of 20-acre exempt parcels.

Alternate Plans for timber harvest along streams without fishes will be written with site-specific considerations to address situations where land owners can meet riparian and aquatic functions at equivalent or better levels, without strictly following the FPHCP prescriptions. However, because of the “equal or better” requirement of the Alternate Plans provisions, and the less-restrictive regulatory requirements for Np and Ns streams, there will likely be few Alternate Plan submittals for Type Np and Type Ns.

Timber Harvest and Site Preparation Activities that Occur Across the Landscape. Yarding is the process whereby the already felled logs are transferred to the loading site (i.e., the landing). Ground-based yarding involves the movement of heavy equipment over the understory vegetation, ground cover, and soil. Regulations governing yarding have not changed substantially since before 2000. Yarding may occur within and adjacent to buffers on both fish-bearing and non-fish-bearing streams. Yarding is expected to occur closer to streams without fishes than to streams with fishes. Under the 20-acre exemption, yarding along perennial streams without fishes will occur closer to the stream than yarding along Type F and Type S stream segments. In general, yarding along Np streams under the 20-acre exemptions will be the same or similar to these activities along unbuffered Np stream segments under standard FPHCP prescriptions.

Logs may be removed from the RMZ by a number of methods. Various types of equipment may enter or approach the RMZ, as long as they do not enter the 30-foot, equipment limitation zone.

Low-impact equipment or cable-suspension will likely be used where soils are saturated or otherwise subject to rutting. Soil disturbance and compaction are expected to be avoided and or minimized by the use of Best Management Practices applied to the handling and moving of the logs within the RMZ. Ground-based yarding and skid trails may occur as close as 30 feet from streams. No logs are expected to be ground-yarded across streams. The use of directional felling is anticipated so that felled trees can be reached by ground-based equipment from the same side of the stream from which they were felled.

Skid trail location, construction, and maintenance are expected to be minimized as specified in the rules (WAC 222-30-070(7, 8)). The rules include BMPs designed to prevent gullying and soil erosion (e.g., minimizing the width of skid trails, using water bars, and revegetation).

Cable-suspension yarding will be used when topography precludes ground-based equipment. Logs will be directionally felled to the outside of any riparian buffers or away from segments of stream. At most, only a minimal amount of the distance over which the logs will be yarded would be within the RMZ. Partial suspension (high-lead) is expected on most logs being yarded across upland areas. Full suspension (sky-line) will most often be required when yarding across typed waters.

Large wood placement in streams is generally done to benefit the aquatic system as well as the fish species which depend upon those habitats. However, short-term (only until the first rain event after placement) effects of wood placement could temporarily modify habitat conditions to a degree that interferes with normal fish behavioral patterns. LWD placement can be done in two different ways: (1) Equipment is used to place the bole with attached root wad into the stream; and/or (2) the bole is adequately secured to the bank or bed. Placement of a bole without an attached root-wad will generally require other methods to secure the piece within the stream. Work using heavy equipment and power tools can take one or more days and might result in some soil exposure. Such LWD placement activities should occur only once per stand-rotation (35 to 50 or more years).

Slash clearing of streams can follow timber harvest or hardwood conversion in riparian areas. It is generally done by hand unless equipment can access the stream without violating equipment limitation zones. Avoidance of soil compaction, rutting, and destabilizing banks is a primary consideration in designing these activities. If the impacts cannot be avoided, the limbs and tree-tops can be left in the stream. Slash clearing work in Type F or Type S streams (and maybe in Type Np or Type Ns waters), will require HPAs. During clearing, workers might walk in the stream and churn substrates.

Soil scarification is a technique used to aid planting as well as natural seeding. Scarification involves the removal of organic matter to expose mineral soil for planting, using either heavy equipment or hand tools. In some cases, removing plants and roots, ripping the topsoil, and exposing the mineral soil is done with a small bulldozer with a variety of blades or rakes. Some machines are designed to scarify patches, while others do more extensive soil disturbance. Chaining is another mechanical treatment used to remove or destroy vegetation in areas with dense shrubs or small trees. Various levels of scraping, plowing, and tilling are also possible, but are used less frequently. Only minor site preparation will occur within the RMZ, because of the prescriptions on riparian harvest.

Road Management. Road management includes the activities and tasks used to construct, maintain, repair, remove, and replace portions of roads and their features. The FPHCP prescriptions emphasize several methods landowners will use to minimize the generation and delivery of fine sediments from roads and road crossings to stream channels as a result of permit issuance. In general, these measures focus on:

- Increased emphasis on upgrading existing water-crossing structures to improve fish passage and passage of floods and wood.
- Additional BMPs to reduce or eliminate the delivery of road-generated sediment will result in some improvement when added to the environmental baseline.
- Improved hydrological connectivity due to the repair of existing road faults and improvement in the design of new roads.
- Additional maintenance measures that are more specific and more frequently articulated in the FPHCP prescriptions than under the pre-1999 regulatory provisions.
- Severe limits and restrictions on roads built in RMZs and other sensitive sites.

Road Construction. The number and location of roads will not be affected by the issuance of the incidental take permit. However, the standards to which roads will be constructed are more stringent than under the regulatory practices that have led to existing conditions. The improved construction standards address the way roads are constructed, but might still result in some level of impact to the physical environment to an extent that interferes with normal fish behavioral patterns in affected watersheds.

Under the FPHCP, road construction will include new road construction and road reconstruction. Re-construction is the upgrading of abandoned roads or construction of new roads at previously roaded locations. Reconstruction could be a common occurrence where timber-harvest activities are proposed in previously harvested areas where road maintenance has lapsed.

Road reopening and reconstruction will occur under normal and emergency situations. Reopening closed roads occurs when a road has been abandoned or put to bed, and it becomes needed again. During emergency situations, closed roads might be reopened to allow access to emergency vehicles and personnel. Reopening closed roads might require removing barriers, knocking down excessively tall water bars, clearing vegetation and downed trees in the travel way, snow-plowing, or reconditioning other roadway features. Temporary culverts could be installed with bedding and clean backfill. Closed roads that have been reopened might then need to be closed after use. Reconstruction is often needed when old roads were primarily composed of cut and fill slopes and used only native soils as surface materials. Reconstruction must meet new road construction standards.

The use of shorter yarding towers has increased the need for new roads. Shorter towers require more landings within (and closer to) harvest units. New road construction includes temporary construction of roads, spurs, and landings. New road construction will continue to decline in amount (number of miles and density per unit area) as road densities become stabilized on the landscape. The FPHCP is not likely to change the number, density, or general placement of these roads, but the standards to which they are built and maintained will be improved relative to historical and recent past practices.

Road construction will typically include: removal of surface vegetation and soil; blasting of rock; excavation of slopes with placement of fill material (cut-and-fill); excavation of slopes and removal (and disposal) of excavated material (full-bench); grading and compacting of sub-grade; rock placement to establish base course; installation of drainage and structural features; placement and finishing of surface coarse; construction of quarries and gravel pits; and marking of road, installation of signs, and installation or construction of other safety features.

Road Maintenance, Abandonment, and Decommissioning. Road maintenance includes the activities that are needed to protect water quality and aquatic resources, meet access needs, provide safe and efficient road operations, and protect the capital investment in the road itself. Road maintenance consists of a variety of activities that contribute to the preservation of the existing road while minimizing delivery of water and sediment to streams. Table 5 describes the activities and tasks used to construct, maintain, repair, remove, and replace portions of roads and their features.

FPHCP maintenance standards require landowners to: (1) keep drainage structures functional; (2) divert captured groundwater from ditch lines onto stable portions of the forest floor; (3) maintain road surfaces to minimize erosion and delivery of water and sediment to typed waters; and (4) slope or water bar road surfaces to prevent water accumulation. Standards for road abandonment require landowners to: (1) slope or water bar roads to minimize erosion and maintain drainage; (2) leave ditches in a condition that minimizes erosion, (3) block roads so that four-wheel highway vehicles cannot pass the point of closure; and (4) remove water crossing structures and fills at high risk of erosion.

In general, the road work proposed in the FPHCP will be spread throughout the action area, over time, rather than concentrated in any one particular area for a short time. Decommissioning will most likely be associated with short spur roads accessing previously harvested units and the overall length of roads decommissioned will be small as many of the roads will be required for long-term silvicultural activities, such as harvest of adjacent stands, pre-commercial stand thinning, and access to monitoring sites.

Exceptions for Road Construction and Maintenance. Small (non-industrial) forest landowners must upgrade fish passage barriers only as the need arises or as otherwise identified through proposed FPAs. However, based on the FPHCP RMAP exceptions for small landowners, barriers will be replaced at a slower pace than required of industrial landowners, and based on State priorities and funding availability. High-priority fish-passage barriers will receive State cost-share funding and will be replaced on non-industrial lands if the barrier is identified for a proposed FPA. Other high-priority barriers could be identified through a number of other processes. Such projects will be addressed through other funding sources (e.g., Salmon Recovery Funding Board). Lower-priority barriers (such as those that access very little upstream habitat) identified for a proposed FPA, and those lower-priority projects not associated with a proposed FPA, might be replaced at any time, but are not required to be replaced prior to the same 2016 deadline that applies to industrial landowners.

Table 5. Description of forest road construction, maintenance, abandonment, and decommissioning activities that influence chronic sedimentation and turbidity.

Activity	**Description of Activity**
Vegetation Removal	Road construction often requires the removal of individual trees or swaths of trees, brush, and other vegetative materials, resulting in the creation of linear forest openings which may vary from 20 to 60 feet. Openings may expand as a result of windthrow. Standing dead trees or hazard trees along constructed roads, but outside of cleared areas might need to be removed. Vegetation removal may occur at anytime of the year and will often be accomplished by the use bulldozers, graders, backhoes, and power tools, such as chainsaws and roadside brushers.
Road grading	Establishing road grades requires the excavation of high spots, hauling of material, and filling across drainages and depressions. Machinery, such as a bulldozer, will be used to establish the topographic grade that will serve as the roads foundation. Machinery will be used to scrape-away vegetative remnants (e.g., stumps, roots, and brush) and remove top soil to prepare the base surface. In some situations, rock features might need to be removed or reduced. Drilling and subsequent blasting may be used. Slopes will be excavated and excavated material will be either removed and disposed off-site, side-cast or end-hauled for other on-site use, or will be stored on-site for later use.
Road construction on steep slopes	Road construction on steep slopes is limited to full-bench construction with end hauling of spoils to avoid side-casting.
Fill	Where fill is needed, it will often be provided from on-site excavation. In some cases, additional fill might be needed or a different type of fill might be needed than was generated on-site. This might result in additional hauling and delivery of fill by dump trucks. In most cases when additional fill is delivered, it will be clean and competent

	rock material.
Finish Sub-grade	Once excavation and placement of fill are complete, the base surface is graded coarsely and might be further compacted. Geotextile material or other drainage or structural features may also be addressed at this time. In some cases, such as temporary roads or in drier areas on acceptable soil types, this may complete the road construction process.
Ballast / Base Course	The base course is created by dumping and spreading rock. The size of rock varies. In some cases, smaller crushed rock will be placed upon or within the larger rock to increase stability. Smaller rock can be hauled to the site or may be crushed on site.
Surface Course	Native surfacing is generally used on low volume roads. Occasionally, aggregate is used to help stabilize moisture-sensitive sub-grades and protect against erosion on erosive surfaces. Materials for the surface course can be brought in by dump truck and composed of clean smaller diameter rock. Once the road is complete, it may be allowed to "set-up" for a year. Surface preparation may include paving. Paving involves spreading of gravel and asphalt and may include sealing.
Geotextile fabric and water stop installation	Geotextile fabric may be used to prevent soil movement or water movement within road prism. Water stops (barriers to movement of water within the ballast and fill) may be installed during construction to prevent "pipelining" of water within the road prism.
Bridge installation	Some bridges may be able to span a floodplain and can be permanent or temporary. Temporary bridges that will be removed prior to seasonal high water may be placed at a lower level across the channel. When bridges cannot span the floodplain, abutments and other supports may be necessary.
Finishing	Finishing the road construction project may involve a number of smaller tasks such as the marking of the road course with reflective posts and installation of signs or other needed safety features. It may include paving and painting of pavement.

Repair of cut and fill slopes subject to excessive raveling, rilling, and slumping	May require flattening the cut slope, widening the ditch, and re-vegetating exposed soils. Armoring may be attempted to stabilize fill slopes. Excavating unstable fill slopes and replacing with stable material may be needed. Sometimes, addition of features to address water movement may be needed. May require the use of heavy equipment.
Blocked roadside ditches	The ditch is cleared with a grader, loader or bulldozer. On aggregate surfaced roads, the waste material is loaded into a dump truck and hauled to a designated waste area
Emergency storm repair	Emergency storm repair may involve placement of fill, wash-out repair, establishing new crossings, etc. Large slide removal generally requires the construction of some type of engineered structure to restabilize the roadway.
Ditch maintenance	A bulldozer or grader cleans ditches by dropping a corner of the blade into the ditch pushing material along. Occasionally an excavator is used to clean out (pull) ditches that have been filled in by large amounts material and/or vegetation. Excess material pulled from ditches is loaded on a dump truck and hauled to pre-approved disposal sites. Sometimes suitable fines are used to replace lost ones in the aggregate surface of the road. Sediment traps might need to be cleared on a frequent basis.
Roadside brushing	Most roadside brushing is done by mechanical removal of trees, branches, and brush. Occasionally, hand tools such as chain saws with regular bars or brushing bars are used. Mechanical brushing is generally done with a road brushing machine that may use a bar or rotating brush head. A number of passes might be made on each side of the road and generally the uphill side takes more passes. Sometimes a pole saw might be needed to reach limbs on the lower side of the road. Chainsaws are used to cut and remove fallen logs from the roadway and roadsides.
Snow plowing	In the spring, the majority of the snow blocking the road is often in drifts. In these cases, drifts are plowed if access is needed. Runoff may continue to wet the road

	surface as snow melt continues from roadside areas. Sometimes when snow is deep, most of the snow is plowed leaving several inches to melt and the road to dry before vehicle use. De-icing agents are not commonly applied on forest roads. On paved roads, de-icing agents (e.g., salt or chemicals such as magnesium chloride) might be used to melt ice or prevent freezing. Sand may be spread for traction.
Dust abatement	Dust abatement (water or chemical) is most likely to occur during periods of heavy traffic or truck hauling within the late-spring to early fall season. In some cases, a treatment might be effective for an entire season, in other cases, repeated application might be necessary in a given season.
Grading	Grading cuts into the road surface so as to loosen material that will re-mix, compact, and bind with underlying materials. A roller may be used to compact the road surface following the final grading passes to prevent further sedimentation. Road grading is most likely to occur during periods of heavy traffic or truck hauling. Routine grading occurs on bridge approaches to keep road surface materials from accumulating at bridges.
Road surface reshaping and resurfacing	The road bed is ripped and new rock is spread, mixed, and compacted into the existing materials. Surface reshaping is most likely to occur during periods of heavy traffic or truck hauling
Road surface rock replacement	Rock is hauled in and dumped at a designated site. A grader is used to spread the rock. A roller may be used to compact and harden the road surface. When the aggregate is dry, water is added prior to blading to prevent segregation and to facilitate compaction.
Culvert installation and upgrade	Culvert installations usually require the use of mechanical tools and heavy equipment such as backhoes, bulldozers, and dump trucks. After a trench to accommodate a culvert is dug, rock can be placed where the culvert will lie in the trench. Fill is placed on top of the culvert in layers that are compacted.

Cross-drainage structures	A backhoe with rubber tires or metal tracks can be used for installation. Depending on the topography and site characteristics, catch basins may also need to be installed. Culverts are installed with a minimum of one foot of fill placed over the top of the culvert.
Culvert clearing	When beavers are plugging culverts the culvert may need to be cleared on a frequent basis. Beaver-exclusion devises may need to be installed and beaver removal may become necessary. Large wood may need to be removed and replaced downstream from culverts on streams with heavy sediment loads or moveable woody debris.
Culvert repair	Culverts may require repair when struck by large woody debris or equipment. Outlets and headwalls may require additional rock. Outlets may require additional energy dissipaters. Repairs may vary in extent from hand-clearing of slash, to major repair with heavy equipment.
Stream diversion during upgrades of culverts or other streams crossing structures	A small segment of the streambed (generally less than 100 feet total) is de-watered and diverted through a bypass pipe or pumped. This might require installation of block dams and might include fish salvage. Dams are typically constructed by hand using sandbags and/or fabric barriers and dirt, and are usually in place for one to two days and generally will be required only once per stream crossing for the effective life of the crossing structure. Following completion of project, water flow is restored.
Bridge abutment repair	Floating woody debris might need to be extracted by chainsaw and/or heavy machinery. Repairs and maintenance might be needed on riprap, decks, guardrails, abutments, sills, approaches, ramps and wingwalls. Many of these activities will require the use of mechanical tools and heavy equipment.
Road upgrading	Additional cross drains, rolling dips and/or enlarged culverts are common upgrading measures.

Stormproofing	Stormproofing might require constructing dips or water bars, installing additional culverts, and/or upgrading existing culverts. It might also involve reshaping the roadway, disconnecting ditches (diverting flow – not relying on ditch flow) and surfacing the roadway.
Bridge repair & replacement	Bridge replacement can range from replacing the decking to the entire bridge including the abutments. Bridge replacement procedures will vary according to the design, size, type and configuration of the bridge. Large cranes and other heavy equipment are used to remove and install bridges.
Installation of Drainage Dips and Water bars	Installing water bars and dips usually requires the use of mechanical and heavy equipment
Surface Material Processing – in place rock crushing	Processing surface material can be accomplished by crushing, blading and re-distributing rock on the road. Binder may be added to an aggregate being used to surface the road, and this can be re-mixed while it is being graded on the road surface.
Road relocation	Relocation entails closing a portion of a road system, and replacing it with a parallel segment of road, usually in the immediate vicinity. In some cases, portions of roads within riparian areas might need to be improved or reconstructed to accommodate the relocation. The road in the riparian area which will no longer be used will be decommissioned according to the applicable rules and the effects are assessed under that activity category. The new segment of road will be constructed according to applicable standards and guidelines. Preparing the road bed and the road prism are will expose bare ground along slopes and in areas of fill. The road prism will be constructed of clean and competent rock. In addition, in order to connect the old and new roads, portions of the old road will need to be excavated and cleared from the

	work area. This will generate some soil that will either be used in new road construction or might require disposal at an appropriate site.
Road re-alignment	Road re-alignment work might occur through widening of the road prism on one side and removing the road prism on the other, or in some cases, a new road prism will be constructed adjacent to or in immediate proximity to the existing prism. Preparing the road bed and the road prism will expose bare ground along slopes and in areas of fill. The road prism will be constructed of clean and competent rock. Suitable material will be brought to the site to create the road prism and will be hauled over adjacent FFR and Non FFR roads. Re-alignment might necessitate the removal of individual trees or swaths of trees. Resulting openings in forest canopy may be as wide as 120 feet. In rare situations, a new corridor through the forest might be created with a narrow band of trees separating the old prism from the new prism. In such situations, the potential for windthrow of the narrow band of trees might be substantial, depending on site-specific conditions and the number and juxtaposition of trees to be retained. In some cases, in anticipation of windthrow, trees may be removed rather than retained. Standing dead trees or hazard trees along such roads might need to be removed to provide a safe work environment and travel corridor.
Road prism widening	The prism is widened by cutting further into the slope and then removing the fill. Additional excavation might require the removal of trees. This can expand the openings in the forest canopy on a temporary basis from about 20 to 60 feet, up to 80 to 100 feet. Over time it is expected that the forest canopy will partially return to its previous width. Removal of fill, as well as cutting of the slope, expose slopes and fill surfaces as previously discussed above.
Culvert Removal	In most cases, culverts and their associated fills are completely removed to return the stream channel to its original width and function. Culvert removal requires the use of mechanical equipment. Small culverts can be removed with rubber-tired backhoes but large culverts might require the use of larger backhoes with metal tracks. Culverts are

	removed from the site for salvage and reuse, or disposal. In some cases, culvert removal might require local construction or reconstruction of access if the site is inaccessible from the road surface or other available areas. Culvert removal includes removal of fill and other supporting structures, and might include stabilization of slopes, steps to address run-off and erosion control, and revegetation. Slopes are pulled back to match the contour so that the stream channel can return to its original form and function.
Sidecast Pullback	This is an operation accomplished by using an excavator to pull material away from a slope. Heavy equipment is used to excavate road sidecast material and reposition it against cut slope areas, or end-haul it to an approved waste disposal site. Work might be confined to road segments that have a potential of failing and delivering sediment to streams and wetlands.
Recontouring	Sidecast material or replacement material is placed back onto the road surface using a large backhoe. Heavy equipment is used to profile (recontour) abandoned road surfaces which will help disperse runoff and reduce potential for failure.
Roadbed Ripping	Roadbed ripping can be accomplished with heavy equipment with teeth, or by using an excavator to scarify the roadbed with a toothed bucket. Ripping helps restore water infiltration and facilitates vegetative growth in the former road bed. Prior to actual ripping, cross-drains and other structures are removed, as is the excessive overburden, running surface, and base. Tank traps (barriers to vehicles) may also be installed at this time.
Water Barring	Water barring is accomplished by using a bulldozer or excavator to dig a trench across the road surface. Water bars prevent erosion and decrease sediment movement by interrupting water flow that would otherwise follow the road bed. They are usually

	placed at 30 to 40 degree angle to road direction and are more frequent on steeper roads or where substantial surface water is expected to accumulate. Road surfaces are also out-sloped as appropriate to reduce potential for cut slope erosion.
Erosion control	Controlling erosion includes excavating excessive fill, re-contouring surfaces, installing slope-stabilization features, and placing wattling, debris, or mulch on surfaces. It involves the dissipation of energy in stream banks when left in new artificial beds through placement of rock or woody debris. It also includes prompt establishment of ground cover and vegetation.
Berm/barrier construction	A berm is a barricade placed to restrict road access and is generally composed of natural material, such as soil, or a combination of excess soil, ditch, logs, rocks, or vegetation. Berm construction is generally done with a small bulldozer, excavator, or backhoe. If needed, a dump truck may be used to haul material to the site. Boulders, logs, root wads, gates, guard rail barriers, or other constructed barriers may also be used to restrict access. Construction might require excavation, digging post-holes, pouring cement, welding, and might also include a minor amount of clearing vegetation for construction of the barrier.
Revegetation	Revegetating areas is important for re-establishing soil and slope stability. Revegetating activities may be accomplished by mechanical or manual means, and by planting or distributing seeds (or seed mixes) or planting seedlings or other vegetative propagules (such as cuttings). Exposed erodible surfaces are often revegetated using hydro-mulching, hay, or bio-matting to protect soils surface during revegetation and to facilitate sprouting and establishment of vegetation. Mulching and fertilizing are also common practices. Vegetation mats and sediment filters may all be used during re-vegetation. In most cases, native species are used. Often, timothy, orchard grass, or bluegrass grasses are used. In some cases, heavy equipment may be used to rip road surfaces to facilitate revegetation.

Road Maintenance and Abandonment Program (RMAP). The FPHCP includes prescriptions requiring landowners to develop road maintenance and abandonment programs (RMAPs) for roads within their ownership. The RMAP is an inventory of forest roads within a particular ownership, an assessment of the current road conditions, and the identification of, and a timetable for, necessary repairs, ongoing maintenance and/or abandonment. The purpose of an RMAP is to prevent sediment and hydrology-related impacts to aquatic resources. Planning requirements differ for small and large forest landowners. For purposes of RMAP development and implementation, a small forest ownership is one that has harvested no more than two million board feet of timber per year.

The RMAP process is intended to bring forest roads into compliance with forest practices standards by July 2016. The RMAPs would require forest landowners to prioritize road maintenance and abandonment planning. Prioritization criteria include 1) the presence of Federal or state listed threatened or endangered fish species or 303(d) listed water bodies, 2) the presence of sensitive geologic formations with a history of mass wasting, 3) the presence of planned or ongoing restoration projects, and 4) the presence of roads likely to have high future forest practices use. Based on a "worst first" principle, RMAPs must pay particular attention to: 1) removing fish blockages, 2) preventing or limiting sediment delivery, 3) disconnecting the road and stream networks, 4) repairing or maintaining stream-adjacent parallel roads, 5) restoring hydrologic flow paths, and 6) capitalizing on operational efficiencies.

Summary of Effects on Fine Sediment Production and Delivery

Timber Harvest Effects. As young forests in previously harvested units grow and mature to mid-seral condition before their next harvest under the FPHCP prescriptions, the environmental baseline condition of the processes that regulate delivery of sediment will improve, with concomitant improvement in habitat conditions for covered species. When added to the environmental baseline, harvest under the FPHCP prescriptions will protect those improved conditions and enable greater improvement of those processes as conditions in riparian buffers mature beyond the mid-seral condition. Riparian buffers minimize the amount of sediment delivered from riparian and upland areas by providing physical barriers to trap sediments moving overland, and interception and dissipation of raindrop impacts (Spence et al., 1996). The Forest Ecosystem Management and Assessment Team (FEMAT 1993) review of literature suggested riparian zones greater than one site-potential tree height from the edge of the channel as adequate to remove most sediment from adjacent hillslopes. After evaluating the effectiveness of Washington's previous forest practices rules in controlling sediment-related water quality impacts, Rashin et al., (1999) recommend that buffers "of at least ten meters should be maintained on all streams in order to avoid chronic sediment delivery and direct physical disturbance of streams from harvest-related erosion." According to Gharabaghi et al.,, "almost all of the aggregates larger than 40 microns in diameter were captured within the first five meters of the filter strip. However, the remaining, smaller-size aggregates are very difficult to remove by filtering."

As noted above, the suggestions in the literature vary in respect to the riparian buffer width necessary to buffer streams from unchannelized surface flow originating from upslope sources. The RMZ widths (combined 50-foot Core and variable-width Inner Zone) for Type S and Type F streams are wide enough to trap most suspended sediment transported as overland sheet flow.

Riparian harvest prescriptions in the FPCHP, including buffer retention and management, would be substantially more conservative than the previous forest regulatory regime. These prescriptions would lead to more functional riparian, stream, estuarine and marine habitats. In turn these results would improve the habitat features affecting local population viability for covered fishes under the proposed FPHCP.

Timber harvest will rarely occur within the RMZ along fish-bearing streams, on unidentified unstable slopes, or because incorrect prescriptions are applied to properly identified areas. Timber harvest within the Inner Zone would avoid exacerbating unstable areas because only limited harvest can occur under the FPHCP riparian stand target requirements. Timber harvest in the Outer Zone or outside the required buffer could accelerate slope failure, delivering sediment to aquatic resources. However, such failures would be rare, and then would likely only occur at the same rate as would have occurred whether or not NMFS issues the ITP.

Movement of heavy equipment within the riparian zones will be very limited and will not occur within the Core Zone. Best Management Practices (such as reduction of pressure from tires and tracks) will minimize rutting and other soil disturbance that would otherwise contribute to erosion and overland sediment transport.

Shade requirements for operations on 20-acre exempt land would lead to retained vegetation and minimized ground disturbance. But the variable treatments that would likely occur on ownerships operated under the 20-acre exemption will likely reduce riparian buffer widths and density, relative to larger ownerships. As a result, riparian areas will not always receive the same sediment filtration protection as they would under the FPHCP prescriptions. Despite the potential for function deficit relative to that which will result under the standard FPHCP riparian prescriptions, the proposed ITP limits application of the 20-acre exemption provisions to certain parcels that presently qualify as exempt and have therefore been “grandfathered” for purposes of this analysis (see section 2.1.4.1.2, above). As determined for LWD above, grandfathering eliminates the possibility of any fracturing of larger ownerships for purposes of gaining application of the 20-acre exemption provision of the Forest Practices Act, enhancing the certainty of this analysis.

The ITP conditions shown in section 2.1.4.1.2 above further limit application of the 20-acre exempt provisions by mandating WAU by WAU thresholds for allowable functional diminution relative to the standard FPHCP riparian prescriptions and requiring the applicant implement a process to monitor such Forest Practices Applications by eligible 20-acre parcel owners to ensure those thresholds are never exceeded. As a result of those limitations, there will never be any WRIA in which the difference between full application of the standard riparian prescriptions and the exempt prescriptions will exceed 9.1 percent less than full function for LWD, and the sediment controlling functions provided in riparian vegetation should reestablish rapidly in parcels harvested according to the 20-acre exempt provisions of the Forest Practices Act, if they are not met immediately after harvest by the vegetation left to meet the shade requirements described above.

Type Np RMZ buffers are 50-feet wide, but are not applied to the entire Type Np network. Type Np and Type Ns waters receive some protection from sediment delivery from 30-foot equipment limitation zones. The potential adverse effects of sediment inputs on aquatic resources would be worse in parts of the action area with a high density of Type N channels. Unbuffered Type N watercourses below harvest units would be subject to temporary (one to two years following harvest) delivery of fine sediment.

Harvest restrictions on unstable slopes and sensitive sites would reduce sediment delivery to streams. These prescriptions would avoid or minimize effects on downstream habitat (such as pool filling and substrate degradation) and covered fish species (from exposure to turbid water which affects feeding and rearing) from the delivery of fine sediments from harvest and site preparation-related activities.

Effects of Road Management. New and reconstructed roads will be built to the specifications described in the FPHCP. Prescribing the amount of cut and fill, road width, road gradients, road surface drainage specifications, stream crossings design, and other construction, reconstruction, and upgrading standards will reduce the likelihood and extent of debris slides from road or water crossing failures and minimize the generation of sediment from surface erosion from new, reconstructed, and upgraded roads. Sediment from these sources cannot be completely eliminated, and with new roads and an unknown amount of reconstructed roads to be built during the next 50 years, small amounts of fine sediment will continue to be generated from these sources.

The ability of forest landowners to successfully minimize sediment delivery from their road network depends on the accurate and timely identification and stabilization of unstable road features that can deliver sediment to waters. The FPHCP requires large forest landowners to fully implement RMAPs by 2016. Upgrades identified in the RMAPs must also be completed by 2016. Corrections of problem roads will begin after all large landowner RMAPs have been submitted, the hazard reduction statute has been evaluated, and determination of need for public funding for repair or abandonment of orphan roads has taken place. Small landowners will also be required to prepare RMAPs, but would not be required to submit them until they file a forest practices application with DNR. Despite all these actions, fine sediment delivery will not be completely eliminated under the FPHCP and the road density per square mile of land will remain relatively high. Therefore, road-related sediment will continue to be delivered to some waters used by covered species and designated critical habitat from roads within the action area, but the frequency and magnitude of events would be reduced.

Road use timing affects the generation of sediment from roads (Reid and Dunne 1984, Mills et al., 2003). Wet season road use is a source of chronic turbidity in streams (Reid and Dunne 1984). Temporary and localized increases in turbidity from activities at stream crossings could adversely affect salmonids. Furthermore, access roads in areas with concentrated harvest activity can deliver greater amounts of sediment following the activity as the road surface is broken down by truck traffic and fine sediments are eroded and transported to watercourses. A recent study in the Oregon Coast Range indicated that detectable turbidity increases at stream crossings during wet weather hauling were limited to approximately 10 percent of the sites when road surfaces were adequately treated (Mills et al*.*, 2003). The limited number of sites that delivered fine material to streams also displayed rapid dilution as turbid water moved into larger receiving tributaries, rendering effects undetectable (Mills et al*.*, 2003). However, turbidity increases were noted where roads paralleled streams. The quality of aggregate used to surface roads is a key predictor of potential sediment yield from rocked roads (Foltz and Truebe 1995). Results from Oregon and Washington suggest that hauling on roads surfaced with high quality aggregate can reduce sediment delivery by several orders of magnitude (e.g., Reid and Dunne 1984, Bilby et al*.*, 1989, Foltz and Truebe 1995).

Heavy equipment might be used in the stream for emergency activities (*e.g.*, unblocking culverts, brushing, spot rocking). In-water equipment use could temporarily affect salmonids and critical habitat, including impacts on redds, smothered or crushed eggs and alevins, increased turbidity and deposition, blocked migration, and disrupted or disturbed overwintering behavior. Pacific salmonids are particularly vulnerable during the fall and winter, when adult salmonids are migrating and spawning, and the spring, when eggs and fry are still present in the substrate. The activities could move juveniles out of overwintering habitats such as side channels and deep pools, into inferior habitats or high velocity waters. Effects during emergency activities during the winter and spring are likely to be localized and short-term (lasting no longer than a day), but can be locally intense, especially if redds are destroyed. Such emergency activities could deliver fine sediments to estuarine and marine waters, causing degradation of the habitats used by covered species.

With the assessment and stabilization schedules established under the RMAPs, the frequency of occurrence for such extensive emergency stabilization treatments will be low. Also, over time, as roads and stream crossings are upgraded to the specifications required in the FPHCP, the necessity for emergency stabilization work will decline. All in-water work will require an HPA, requiring prevention or minimization of short- and long-term impacts to streams and fishes. The short-term impacts would be further offset by the immediate and long-term benefits provided from stabilizing fill, preventing culvert blow outs, minimizing erosion problems, and providing upstream fish passage.

Adverse effects on covered fish species and their habitat from road construction, maintenance, and abandonment are caused primarily by delivery of fine sediment. In the long-term (over the next 10 years), roads practices under the FPHCP will reduce fine sediment generated from the existing road network and lead to levels that will maintain ecological functions throughout the action area relative to the effects of practices that created existing baseline conditions. This result would come from the emphasis on: (1) identifying unstable slopes and requiring greater environmental review for new roads planned for potentially unstable slopes; (2) inventorying roads; and (3) scheduling and upgrading roads to new standards prior to 2016. Although not considered in the jeopardy analysis herein, it is worth noting that CMER has already identified the intent to test basic assumptions related to road rules through the adaptive management program.

2.1.4.2.4 Effects of Sediment from Mass Wasting Processes. As stated in greater geographic detail above, the environmental baseline throughout the entire action area exhibits the effects of excess sediment from past activities. Several watersheds in the action area have been listed under the Federal Clean Water Act as impaired by sediment and/or turbidity. Based on the information provided in the baseline for each WRIA, mass wasting affects aquatic habitat across the entire action area, especially areas west of the Cascade crest.

On a unit area basis, roads have the greatest effect on mass wasting of all forestland activities (Sidle et al., 1985). Studies of effects of timber roads and harvest before about 1997 suggested that harvest-related mass wasting occurred with approximately the same frequency as road-related landslides (Montgomery et al., 1998). Road location, drainage, design, construction, and maintenance are all important factors in effective road design, and can be contributing factors to road-related failure. New road construction and engineering design has reduced road-related mass wasting relative to roads constructed more than 15 to 20 years ago (Toth 1991; Robison et al., 1999).

Shallow-rapid landslides (SRLSs) and debris flows (i.e., channelized landslides) are the most common types of landslides in steep forestlands. Still, typically only a small fraction of the landscape is affected at any given time (Ketcheson and Froelich 1978; Ice 1985). SRLSs and debris flows are initiated by high amounts of ground water, typically from road-directed flows, or high magnitude rain or rain-on-snow events during the fall and winter months (Swanson et al., 1987). Sidle et al. (1985) summarized several studies (Swanston 1970, 1974; O'Loughlin 1974; Ziemer and Swanston 1977; Burroughs and Thomas 1977; Gray and Megahan 1981; Ziemer 1981) indicating that slope stability depends partly on reinforcement from tree roots, especially when soils are partly or completely saturated. Clearcut timber harvesting on potentially unstable slopes decreases rooting strength, increasing the potential frequency and magnitude of SRLSs and debris flows (Ziemer and Swanston 1977).

Shallow-rapid landslides that enter steep, headwater channels can become channelized landslides that quickly carry a slurry of wood, water, and all sizes of sediment downstream until reaching a flatter channel or a sharp channel junction. Channelized landslides usually transport more material than the initiating event, due to scouring action in the channel. Channelized landslides contain substantial amounts of wood and can travel varying distances, which can cause variable degrees of impact depending upon channel gradient, confinement, layout of the channel network, and other characteristics (Fannin and Rollerson 1993). Channelized landslides can have long-lasting effects on stream channels by removing boulders and large wood pieces and scouring or depositing large amounts of sediment. The channel location and cross-section can be radically altered in such a way that normal flows and normal peak flows cannot reconfigure the channel easily (Lamberti et al., 1991). This is important because even though mass wasting might affect only a small fraction of a watershed, channelized landslides can affect up to 10 percent of the stream system because of their mobility (Swanson et al., 1987).

These channel alterations are not always adverse over the long term. For example, Benda et al.

(2003) found that channel morphology and habitat complexity (e.g., pool density, substrate texture, and channel widths) increased in proximity to low-order tributary confluences prone to debris flows. Deposits of large-sized wood and course sediments resulted in biologically more productive sites. In addition to having impacts on the stream channel, channelized landslides can also affect riparian buffer functions and streamside forests when bank scour is so great that streamside vegetation is removed or terraces are formed. New terraces are good sites for the development of early-seral riparian forests.

Regardless of the source, past management-related mass wasting has caused persistent changes to stream habitats throughout the action area. Reeves et al., (1995) observed that the frequency and pattern of watershed disturbances (e.g., mass wasting with large wood) strongly influenced the quality and distribution of salmonid habitat on the Oregon Coast. While channelized landslides cause short-term (lasting between 12 and 18 months) adverse changes in aquatic habitats, and many stream channels have segments that receive excessive sediments or scour, some streams would experience beneficial changes as landslide-deposited boulders and wood become stable channel features.

Although the proposed FPHCP does not change existing regulations regarding the protection of unstable slopes, conditions influenced by mass wasting would continue to improve over the period of the permit term. Timber harvesting would be conducted to decrease the likelihood and extent of management caused mass wasting. Roads would be treated to reduce the likelihood of management caused mass wasting and reduce or eliminate sources of sediment. Gradually, channels would respond to the reduced sediment delivery rates by forming more frequent pools and higher quality pool habitat for juvenile rearing and adult holding, improved spawning habitat and improved water quality conditions.

Mass wasting from headwaters and adjacent steep streambanks is a principal mechanism for the delivery of sediment to stream channels. Once in the stream channel, the quantity and transport rate of sediment supply dominantly influence the distribution and quality of habitat for Pacific salmonids. Excessive rates of sediment supply manifest as increased levels of fine sediment in the streambed, widened channels, filled pools, and, in the case of extremely high sediment yields, braided channels.

Mass wasting causes a range of physical changes experienced by salmonids and their habitat, including 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 fishes. Not all changes are evident at all sites. In the action area, excessive sedimentation, due principally to mass wasting and streambank erosion has decreased the quality of both spawning and rearing habitats. Limiting factors analyses throughout the state indicate that excessive sedimentation rates have led to embedded stream substrates and simplified juvenile rearing habitat.

Upstream sources of sediment are controlling factors for accretion or erosion in the estuary. Excess sedimentation can result from timber harvest in the catchment basin (Levings and

Northcote 2004). Therefore, a range of potential impacts to the habitat of covered species in the estuarine and marine waters from sediment delivered by mass wasting events is possible. These changes include increased rates of sedimentation leading to reduced rearing capacity (Tschaplinski 1987) and changes in grain size composition in areas where some covered species spawn and rear.

Proposed FPHCP Measures Influencing Mass Wasting

The FPHCP's prescriptions addressing slope stability would continue to include the goal of continuous improvement and refinement. The intent of the prescriptions is to decrease the likelihood and extent of sediment delivery from mass wasting to aquatic resources. Specifically, the riparian harvest prescriptions control activities which can influence the delivery of sediment to aquatic resources.

The prescriptions that address potentially unstable slopes and landforms are derived from an outcome-driven decision-making process conducted in accordance with the forest practices rules and SEPA. The DNR would evaluate proposed timber harvest and construction activities on unstable slopes to determine if the activities would have a "probable significant adverse impact." The determination is based on the agency's evaluation of the proposal, conducted in consultation with other affected agencies and tribes, as well as comments received from interested parties through the SEPA review process.

The only exception to this decision-making process occurs in areas where a Watershed Analysis has already been conducted and approved by the State, resulting in existing management prescriptions addressing potentially unstable slopes. In such cases, the prescriptions are specific to the site or situation and do not call for additional analysis (WAC 222-16-050(1)(d)(iii)). In these cases, proposed timber harvest and construction activities on unstable slopes must adhere to the approved watershed analysis management prescriptions.

Potentially unstable slopes or landforms with a high likelihood of failure and delivery of materials to watercourses are defined as one of the following: (1) Inner gorges, convergent headwalls, or bedrock hollows with slopes greater than 35 degrees (70 percent); (2) Toes of deep-seated landslides, with slopes greater than 33 degrees (65 percent); (3) Ground water recharge areas for glacially derived soils with deep-seated landslides; (4) Outer edges of meander bends along valley walls or high terraces of an unconfined meandering stream; and (5) Any areas containing site features indicating the presence of potential slope instability which cumulatively indicate the presence of unstable slopes (WAC 222-16-050(1)(d)(i)).

The FPHCP's prescriptions address timber harvest and road construction on potentially unstable slopes or landforms that have the potential to deliver sediment to streams. As such, the main vulnerability under the rules would be those few instances when the proposed identification process mistakenly fails to identify all the potentially unstable slopes and unstable features. In any such cases, timber harvest within Inner Zones will seldom exacerbate any existing instability because harvest in the Inner Zone must meet required basal area targets that mimic mature natural stand conditions. Timber harvest in the Outer Zone or outside the required buffer might occasionally result in local slope failure and might result in delivery to aquatic resources. Failure to identify such areas would be rare and would most likely occur only in marginal cases, where the unstable feature is too small to be identified through the DNR evaluation process.

Given this result, the FPHCP's hillslope mass wasting strategy, imposed across the action area, would decrease the likelihood and extent of disturbance frequency relative to historical and recent past levels under previous regulatory regimes.

2.1.4.2.5 Effects of Proposed Action on Stream Temperature. Summer high stream temperatures are a concern throughout the action area, especially in areas of floodplain channels where conditions are influenced by either agriculture or urban/residential development. Many river and stream segments are listed as impaired on the basis of water temperature. Riparian conditions in managed forestlands have been affected in areas where past timber harvest was conducted under rules requiring less, if any, riparian tree retention than the rules that have been in place since around 2000. As a result, those past harvests removed shade-providing vegetation, increasing water temperature. Temperature-focused total maximum daily loads (TMDLs) developed for streams and rivers in Washington have predicted that affected stands will require between 50 and 80 years to restore natural temperature conditions, depending on location and type of riparian vegetation, (NMFS and USFWS 2005).

Small streams are particularly vulnerable to temperature changes. But recovery of the natural temperature regime after timber harvests can be relatively rapid in small stream channels, because temperature-reducing vegetation need not be nearly as mature to provide temperature reducing shade conditions for small streams. Conversely, the influence of riparian harvest on temperature in wider channels (i.e., greater than 30 feet) tends to be less significant, because, even under natural conditions, the channel is only partially shaded by riparian trees and water temperatures are naturally higher. However, tall trees do affect water temperature on larger channels, meaning temperature regime recovery from riparian timber harvest does take longer than for small streams. In some areas, this problem is compounded by the fact that the majority of the riparian buffers affected by timber harvest have regenerated as hardwood-dominated stands (i.e., greater than 70 percent hardwoods). In other areas, severe debris torrents in steep channels can remove enough riparian trees to impact shade and water temperature (Beschta and Taylor 1988, Coho and Burges 1994).

The FPHCP's prescriptions addressing riparian harvest provide for substantially more shade-protecting, temperature-reducing vegetation retention than under historical and recent past regulatory regimes, especially along fish-bearing streams. Most existing stream shade along fish-bearing streams would be retained during harvest operations. Therefore, the amount of shade produced along riparian zones under the FPHCP would increase, relative to baseline conditions that resulted from past practices. Along non-fish-bearing streams, the amount of shade would be likely to remain similar if not the same as conditions in the environmental baseline.

There are several factors that make up the heat balance of water, including: solar radiation, air temperature, evaporation, convection, conduction, and advection (Brown 1983; Adams and

Sullivan 1989). Stream temperatures have a natural tendency to warm from upstream to downstream in the watershed (Sullivan et al., 1990; Swieniecki and Newton 1999). Seasonal and diurnal variability also exists with stream temperatures. Other site-specific factors such as latitude, regional climate and weather, stream size, groundwater inflow, and distance from watershed divides also affect stream temperature (Beschta et al., 1987; Sullivan et al., 1990). During the summer when stream temperatures are the highest, the combination of warmer air temperatures, increased direct solar radiation, and decreased stream flows are the major factors affecting stream temperature (Beschta et al., 1987). Of these three factors, forest management can have the greatest effect on direct solar radiation by reducing shade. Shade alone does not physically cool the stream, but it prevents further heating of the stream and maintains the cool water temperatures from groundwater inputs or tributaries (Oregon Forest Practices Advisory Committee 2000). Shade from riparian vegetation has been shown to minimize or eliminate increases in stream temperature associated with timber harvest (Brazier and Brown 1973; Lynch et al., 1985). Other factors that affect shading include local topography, stream size and aspect, stand age, composition, and stand density.

Sustained high stream temperatures are considered potentially harmful to salmon because these species are adapted to the specific, natural temperature ranges of their natal streams. Laboratory studies concluded that changes in stream temperature ranges can alter salmon development, growth, survival, and the timing of life history phenomena (Beschta et al., 1987). Based on the conclusions of these laboratory studies, increased temperatures beyond those meeting the biological requirements of salmon could cause juvenile salmon to seek other rearing areas or decrease their rates of growth. Furthermore, Berman and Quinn (1991) reported that fecundity and the variability of spring Chinook salmon eggs were adversely affected by greatly elevated water temperatures above those meeting the biological requirements of Chinook. Severely high temperatures can inhibit the upstream migration of adult salmon and increase the incidence of disease throughout a salmon population. Finally, a study in coastal Oregon found that as stream temperatures increase, competition between rearing salmon and warmwater fish species can increase, potentially extirpating salmon populations through competitive pressure (Reeves et al., 1987).

In the upper intertidal zone of estuarine and marine habitats, temperature is an important factor in the ecology of at least two species of forage fishes. Surf smelt and Pacific sandlance spawn in upper intertidal beaches with substrates of sand and/or fine gravel (Pentilla 1997). The loss of shade provided to the spawning beaches by riparian vegetation produces elevated substrate temperatures at low tide. Elevated temperatures on beaches have been linked to a significant reduction in the hatching success of surf smelt (Pentilla 2001).

Pacific sandlance are known to burrow into intertidal beaches during the winter (Quinn 1999). During periods of elevated temperatures and low tides, interstitial dissolved oxygen is depleted, and these fish may emerge from the sediment and either dry out thoroughly or become easy prey for a host of predators (Quinn and Schneider 1991). Loss of riparian shade could contribute to the high substrate temperatures and low oxygen events and adversely affect Pacific sandlance.

FPHCP Measures Influencing the Effects of Harvest on Stream Temperature

The proposed FPHCP measures that would most likely influence stream temperature are the harvest prescriptions for the riparian management zones. In summary, the western Washington RMZs for Type S and F waters are divided into three zones along the stream: the Core Zone is adjacent to the bankfull width or CMZ outer edge; the Inner Zone is adjacent to the Core Zone, and the Outer Zone is adjacent to the Inner Zone and is farthest from the water. The Core Zone is western Washington is 50 feet in width. With the exception of approved road crossings and narrow yarding corridors, no timber harvest or construction is allowed in the Core Zone.

The Inner Zone varies from 10 to 100 feet in width, depending on stream size, forestry site class on adjacent lands, and the management option selected. Timber harvest in the Inner Zone is permitted only when the riparian characteristics of an existing stand exceed the riparian stand target requirement. The stand requirement is the number of trees per acre; basal area per acre; and the proportion of conifer, in the combined Inner Zone and adjacent Core Zone, that will provide ecologically functional riparian stand conditions when the stand is 140 years old. When the existing stand in the combined Inner and Core Zones does not meet stand target requirements, no harvest is permitted in the Inner Zone, except for the purpose of hardwood conversion.

Landowners have the option of converting hardwood-dominated riparian stands to conifer-dominated stands in the Inner Zone of the RMZ in western Washington only. The riparian areas must be hardwood-dominated stands with site evidence that conifers were dominant in the past. The objective of the hardwood conversion rule is to improve long-term (greater than 40 years) riparian function by growing sizeable conifers. This would be accomplished by allowing landowners to remove most hardwoods in the conversion area and restock the area with conifers. There are numerous other requirements and restrictions to implementing hardwood conversion.

Timber harvest in the Outer Zone must leave at least 20 riparian leave trees, of a certain type and size, per acre after harvest. These trees must be left uncut throughout all future harvests.

In western Washington, two types of buffers are defined for non-fish-bearing waters. First, an Equipment Limitation Zone (ELZ) is defined for all Type N streams. Second, a 50-foot-wide buffer is required for at least 50 percent of Type N perennial streams.

The area between the bankfull width edge of Type N water and a line 30 feet from such an edge is established as an ELZ. Landowners must mitigate for the disturbance of more than 10 percent of the soil within any ELZ as a result of the use of ground-based equipment, skid trails, stream crossings (other than road crossings), or partially suspended cabled logs.

At least 50 percent of the length of Type Np streams will receive a 50-foot no-harvest buffer. Groundwater seeps, hyporheic zones, and other sensitive areas that provide cool water will also receive protection from forest practices with 50-foot no-harvest buffers. Additional buffering will occur where trees are retained on stream-adjacent unstable slopes. High hazard unstable slopes including channel heads, bedrock hollows, and inner gorges are commonly associated with Type Np channels and are often treated as no-harvest areas. In western Washington, 56-foot radius no-harvest buffers are required at Type Np confluences. In addition, where an Np stream meets a Type F or S stream, a 50-foot no-harvest will be required for the first 500 feet upstream of the confluence with the Type F or S stream. One reason for the 50-foot no-harvest RMZs along the lower 500 feet of Type Np streams is to allow water temperatures to equilibrate to shaded conditions prior to mixing with, or becoming, a Type F or S stream. Additional acres equal to the number of acres occupied by an existing stream-adjacent parallel road within a specified sensitive site buffer or priority area must also be added. Landowners are also required, to the extent reasonably practical, to avoid creating yarding corridors and road crossings through sensitive sites and to avoid vegetation removal in perennially moist areas.

In eastern Washington, RMZs for Type S and F waters are also divided into a Core, Inner, and Outer Zone. The Core Zone in eastern Washington is 30 feet in width. The Inner Zone varies from 45 to 70 feet in width, depending on the steam size and site class of adjacent lands. The degree of timber harvest permitted in the Inner Zone varies by habitat type. The width of the Outer Zone is 0 to 55 feet depending on the site class and stream width. The number of leave trees required in the Outer Zone also depends on habitat type.

In eastern Washington, buffer zones for non-fish-bearing waters are defined in two ways. First, a 30-foot ELZ is defined for all Type N waters. Second, a buffer is required for Type Np streams, based on whether the unit is subject to a partial or a clear cut harvest. Additionally, if a road exists in a Type Np RMZ and the basal area required to be left cannot be met within 50 feet of the stream due to the presence of the road, then the shortfall of basal area must be eliminated by shifting the RMZ location.

Twenty-acre Exempt Parcels. On some 20-acre parcels (those where total ownership is less than 80 acres), harvest may occur under an alternate set of rules (WAC 222-30-023) known generally as the 20-acre exemption. Buffers will be retained according to pre-2000 rules, plus 15 percent of the timber volume. In western Washington, RMZs must be at least 29 feet wide. In eastern Washington, the minimum width depends on the harvest type (partial or clear cut), but is at least 35 feet in width. In addition, shade requirements must be met on type F and S streams. Buffers on type F and S streams are measured from the bankfull width for 20-acre exempt parcels (as opposed to the outside of the channel migration zone for standard rules). Under the 20-acre exemption, ground-based yarding in riparian areas may occur closer to streams than under standard rules. No RMZs are required on Type Np streams on exempt 20-acre parcels. As stated in section 2.1.4.1.2 above, the application of the exempt provisions are limited across the action area by the proposed ITP conditions. The result of the application of the limit will be to reduce the potential extent of units harvested leaving functional deficit relative to the level of function that would exist after harvest under the standard FPHCP riparian harvest prescriptions.

Shade Rule. In addition to the RMZ requirements, leave trees are retained in RMZs on Type S and F waters as provided by a specified method described in the Forest Practices Board Manual (1995), which includes several considerations: (a) Minimum shade retention requirements; (b) Regional water temperature characteristics; (c) Elevation; and (d) Temperature criteria defined for stream classes in WAC 173-201A. This method is used to establish the minimum required shade cover based on site-specific characteristics. When site-specific data indicate that pre-harvest conditions do not meet the minimums established by the method, no additional shade removal from RMZs is allowed.

No tree can be harvested within 75 feet from the edge of the bankfull width or the outer edge of the CMZ (whichever is greater) of any Type S or F water if, according to the temperature prediction method, the tree is providing shade to the typed water. These shade requirements must be satisfied whether or not the Inner Zone includes a stream-adjacent parallel road. However, harvest of shade trees in connection with the construction and maintenance of road crossings or the creation and use of yarding corridors may occur within certain guidelines.

Effects of FPHCP Measures on Water Temperature

Among other functions, the FPHCP riparian buffer prescriptions will protect existing overstory canopy at the time of harvest and enable further development of the shade function described above after harvest occurs. As stated above, removal of overhead canopy cover can increase solar radiation reaching the stream, increasing water temperature within the stream (Spence et al., 1996). The literature is replete with investigation of the relationship between shade function and stream temperature maintenance. Spence et al. (1996) reported that old-growth stands provided between 80 and 90 percent canopy cover from studies in western Oregon and Washington. Based on reviews 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 170 feet (100-year Douglas-fir, site class 2), this buffer width should be 127 feet to provide 100 percent shading effectiveness.

Notwithstanding the investigations cited above, there remains uncertainty regarding the relative extent of shading in forested RMZs from effective buffer width and the relationship between that shade stream temperature protection across all stream types and buffers. The buffer width targets taken from the literature were largely derived from studies of sites (i.e., large streams and rivers) that might not be representative of the operational sites within the action area covered by the FPHCP. In absolute terms, the buffer widths prescribed in the FPHCP, are smaller than the 0.75 height potential tree height cited in the FEMAT; 100 feet cited in Beschta et al. 1987, and Murphy 1995, for 100 per cent shade function on larger streams and rivers in the action area. In contrast, functional shade on smaller streams, in fact, might actually require smaller buffer widths for those waters.

The FPHCP's stream typing and associated riparian prescriptions increase the retention of shade provided to the drainage network compared to prescriptions under the pre-2000 forest practices rules. Under the FPHCP, the overall RMZ widths for Type S (including estuarine and marine shorelines) and F streams exceed the buffer width recommended in the literature (FEMAT 1993) to provide complete shade. Because no harvest is allowed in the Core Zone, except for allowable road crossings and yarding corridors, almost all available shade within 50 feet of the stream will be retained along Type S and F waters. However, some level of shade reduction is expected due to allowable harvest in the Inner and Outer RMZ.

As stated previously in this Biological Opinion, NMFS assumes that RMZs on 20-acre exempt parcels will receive less extensive RMZs than under the FPHCP prescriptions summarized above. However, the ITP limits the concentration of parcels harvested under the exempt provisions (section 2.1.4.1.2, above). Furthermore, under the FPHCP, exempt parcels will be operated according to the shade rule for those parcels. Under the shade rule, RMZs on exempt parcels will have to retain enough trees to meet the minimum shade requirements for achieving required State water temperature standards. These standards are not presently associated with the biological requirements of salmonids, and RMZs on 20-acre exempt parcels are not likely to provide theoretically maximum shade (in terms of the density of tall trees). Nevertheless, the effect of these differences on western Washington stream and estuarine and marine shoreline temperatures is likely to be negligible given the dispersed and limited extent of affected lands.

Since large extents of RMZs in the action area are presently early-seral, they would not likely to provide full shade function in the short-term (i.e. less than five years), whether or not NMFS issues the proposed ITP. In contrast, mid-seral RMZs will develop to a point where canopy closure will be sufficient to produce shade comparable to a late-seral stand in 20 years or so, and the FPHCP prescriptions will conserve more of that function when those stands become ready for commercial operation. Core Zones that are presently under-stocked, hardwood-dominated stands as the result of operations under previous regulatory regimes might not attain shade levels typical of an old-growth conifer forest (NMFS and USFWS 2005). Past logging practices caused these conditions and effects, and they are common in the environmental baseline in the action area. Large portions of forestland in the action area have been understocked, or are in early- to mid-seral stages as the result of historical fires (Bisson et al., 1987**)**. Therefore, prescriptions for operations under the FPHCP better enable the development of shade. These functional developments will likely be slow to occur, but will yield long-term improvements, requiring at least five years to develop.

While difficult to quantify, buffering of unstable slopes substantially increases stream shade and temperature protection along many Type Np waters, particularly in western Washington with its higher frequency of unstable slopes and landforms. Following operations in places containing unbuffered type Np channels, water temperature exceedances are likely to result until some streamside vegetation develops. However, the potential for increased temperatures will be reduced by overhanging shrubs and young trees, which can provide effective shade for Type Np waters in many cases.

Operations near Type Ns streams will not likely adversely affect temperature because these streams are typically dry during the warmest summer months, when the waters are most vulnerable to warming. However, the few Type Ns streams that have water present during this time might not have adequate shade from overstory trees to maintain stream temperature as these streams receive no buffers under the FPHCP. Local topography, shrubs and debris along the streams can provide adequate shade; but because of this uncertainty, there is a high likelihood of water temperature increases in Type Ns streams where water is present during the summer months (July through September). Importantly for this analysis, this result would likely occur whether or not NMFS issues the proposed permit.

In general, the no-harvest portions of RMZs and the implementation of the shade rule will provide a higher level of protection and an increase in shade in areas where applied, compared to the rules in effect prior to January 2000. All factors considered, the overall RMZ effectiveness for providing shade protection to Type S and F streams is high. However, potential increases in water temperature may occur along Type Ns and unbuffered segments of Np streams. Places that risk increases in water temperature in Type Ns and Np streams include those with bedrock channels, those where the lower 300-500 feet above the confluence with a Type F or S stream are already degraded, those where the lower 300-500 feet above the confluence with the Type F or S stream is in a non-forestry land-use, or those eastern Washington Type F or S streams that lie outside the Bull Trout overlay described in the FPHCP.

Overall, the likelihood of adverse temperature effects is considered low for most Type S and F western Washington streams and marine and estuarine areas, moderate for areas where harvest Option 1 will be implemented and in lower elevation basins (less than 1,640 feet) where water temperatures are already warmer and more sensitive to changes in shade, moderate for eastside streams outside the bull trout overlay, and low for eastside streams within the bull trout overlay, which includes most of the action area on the eastside. Temperature conditions, and therefore protection of fish resources, are expected to improve relative to baseline conditions.

2.1.4.2.6 Effects of Proposed Action on Nutrient Inputs. Allochthonous inputs (nutrients derived from outside the aquatic system typically through leaf and needle (i.e., detrital) inputs) drive the primary productivity of nutrients in streams in the action area . Leaves and needles, along with other biological material falling into streams from riparian vegetation, supply nutrients and food for aquatic organisms (Gregory et al., 1991; Richardson 1992) that form the bottom of the food chain in those streams. Red alder is one of the most important sources of detrital inputs to lower order streams. Red alder, a common early-seral tree in RMZs (Murphy and Meehan 1991), fixes atmospheric nitrogen and the leaves rapidly decompose in the stream, providing a ready source of nitrogen for primary productivity. The organisms in the base of the food chain that rely on those inputs are ultimately the food base that juvenile salmonids consume when rearing and migrating to the ocean.

Studies indicate that nutrients from a variety of sources increase in the first few years following logging (Hicks et al., 1991). Where light is provided to the stream, these increases in primary productivity can enable increases in individual juvenile salmonid growth, but effects on overall salmonid production have not been detected related to these increases (Hicks et al., 1991). In contrast, past harvest activities are believed to have reduced leaf and litter supply in some places throughout the action area. As forest practices regulations in the action area have required increasing conservation of streamside vegetation during operations, detrital inputs have likely increased. Before no-harvest zones were applied along streams, hardwood (i.e., red alder) or brush stands often replaced harvested conifers in the riparian zone, especially when natural regeneration was common practice. Currently, at least 50 percent of the riparian vegetation in western Washington is composed of hardwoods, largely red alder and bigleaf maple.

Under the FPHCP, landowners in western Washington have the option of converting hardwood-dominated riparian stands to conifer-dominated stands in the Inner Zone of the RMZ. Conversion of “artificial” stream-side hardwood or brush stands to conifer stands is often conducted with the intent of creating a stand of mature conifers that can provide large conifer LWD that is more persistent once delivered to the stream than woody debris derived from hardwood species. Hardwood to conifer stand conversion is only allowed on sites that naturally supported mature conifer before previous management. Lands that are best-suited for hardwoods are generally retained as hardwood stands because they are difficult to convert and biologically inappropriate to convert.

Hardwood-dominant riparian stands might also naturally convert to mixed hardwood-conifer stands. Over time, as alders age, die, and fall, already established conifers typically out-compete the next generation of red alder, resulting in a gradual reduction of red alder inputs to the stream and some change in detrital input to the riparian zone and stream.

During intentional hardwood conversions, possible reductions in alder detrital inputs would be ameliorated by: (1) the untreated CMZ and the 50-foot no-harvest Core Zone adjacent to Type S and F streams and portions of Type Np streams; and (2) the fact that few landowners (i.e., less than one percent of all forest practices applications) have converted riparian hardwood stands to conifer stands since the current forest practices rules went into effect in January 2000. Under the proposed action, few eligible sites are likely to be converted. Given the prevalence of red alder across the action area, and the inherent patterns of riparian disturbance, will continue to be a significant source of allochthonous inputs.

The amount of detrital input will remain high, and benthic invertebrate production diverse, even in recently harvested riparian areas, mainly because of retention of detrital sources in CMZs and the no-harvest Core Zones of RMZs. Compared to baseline conditions, the amount of leaf and needle delivery is expected to improve as riparian stands grow into older mixed hardwoods and conifers. Retained streamside vegetation will, over time, provide nutrient input levels that meet the biological requirements of salmonids. Therefore, the activities prescribed under the proposed action should cause no detectable changes in salmonid production from changes in stream nutrient loads. However, the persistent lack of other sources of nutrients, particularly those supplied from adult salmon and steelhead carcasses, which are already low because of presently low salmonid abundance, will remain low until salmon numbers increase.

2.1.4.2.7 Other Effects of the Proposed Action

Removing Barriers to Fish Passage. Some fish habitat on FPHCP lands is currently inaccessible due to human-caused blockages at road crossings. Constricted flows at culverts or bridges resulting in fish blockages are largely due to poor installation, undersized structures, or neglected maintenance. In many instances high water velocities amplified by undersized culverts have created large scour pools at the culvert discharge point, altering the stream elevation below the natural gradient. Over time, culverts have become elevated above the stream and created a physical barrier to fish passage. In other cases, water draining under and around culverts has created attraction flows, causing migrating fish to become stranded or impinged against the culvert or road fill.

Fish passage has been an important issue since it was first addressed by forest practices in 1975. Current forest practices rules (i.e., the FPHCP) require landowners to review their roads to determine if they have fish blockages. Large forest landowners are required to inventory and evaluate road crossing structures and identify fish blockages (e.g., culverts, bridges, and other road crossings) in their RMAPs. All fish passage barriers on road crossings owned by large landowners must be removed by the end of 2016. Culverts affecting the most stream miles would be fixed first. Small forest landowners have two options for meeting RMAP requirements. Small forest landowners may follow the RMAP process for large forest landowners or they may submit a "checklist" RMAP with each forest practices application or notification (WAC 222-24-051(1)). If a fish blockage is identified on the "checklist" RMAP, a small forest landowner has two options: (1) participate in the DNR-administered cost-share program that provides financial assistance to small forest landowners who have fish barriers on their lands; or (2) if not participating in the cost-share program, a small forest landowner must correct any fish passage barriers on forest roads within their ownership that are covered or affected by an active forest practice application. If small forest landowners participate in the cost-share program, they are not required to fix fish-passage barriers until cost-share funding is available and higher priority fish-passage barriers on other lands in the watershed have been repaired. Like the RMAP process for large forest landowners, the goal is also to correct all fish passage barriers on small forest landownership by 2016.

The goal of the FPHCP is to replace most if not all fish passage blockages in the first 15 years of the HCP. Species most likely to benefit during the first several years of implementation are those inhabiting reaches lower in a system, as these barriers are more likely to be corrected first. Conversely though, it is likely that fish-passage blockages are more abundant in the headwater streams where the forest-road network is more concentrated. These barriers are expected to be replaced later in time as technology improves making such replacement options more economical (WDNR 2004).

The overall impact of the FPHCP on fish habitat is expected to be beneficial. Removing fish-passage blockages will restore spatial and temporal connectivity of streams within and between watersheds where fish movement is currently obstructed. This, in turn, will permit fish access to areas critical for fulfilling their life history requirements, especially foraging, spawning, and rearing. Since 2001, approximately 705 miles of previously blocked streams have been opened to fish passage and over 1,200 structures have been removed or replaced under the RMAP process (WFPA 2005).

However, the removal of fish passage barriers could have short-term (typically lasting less than one week, depending on the duration of in-stream work) temporary effects to fish. Heavy equipment might be used in the stream for unblocking, removing and replacing culverts and bridges activities. In-water equipment use could temporarily affect salmonids and critical habitat, including impacts on redds, smothered or crushed eggs and alevins, increased turbidity and deposition, blocked migration, and disrupted or disturbed overwintering behavior. Salmon are particularly vulnerable during the fall and winter, when adult salmon are migrating and spawning, and the spring, when eggs and fry are still present in the substrate. The activities could move juveniles out of overwintering habitats such as side channels and deep pools, into inferior habitats or high velocity waters. Such activities could deliver fine sediments to estuarine and marine waters, causing degradation of the habitats used by covered species.

With the assessment and replacement schedules established under the RMAPs, the need for in-stream work, dewatering, and fish capture/handling will diminish over time, until most, if not all, blockages are eliminated by the end of 2016. Adverse effects from fish passage barrier removal will be further minimized by following protocols (e.g., NMFS electrofishing guidelines, and WDFW HPAs) that require: (1) work timing windows; (2) sequential dewatering of streams, which allows fish to recede with the water, and avoid exposure to electroshocking, and 3) qualified electrofishing personnel. The short-term impacts will be offset by the immediate and long-term benefits provided from providing upstream fish passage.

Fish Salvage. Fish salvage (isolation, capture, and handling) may occur when diverting a stream for instream work. The fish would be netted and placed back into the stream in a secure location. There is a potential for a small number (up to five percent) of juvenile fish that are present in the stream to avoid being captured and relocated, and thus die because they remain undetected in stream margins under vegetation, rocks, or gravels.

Fish handling has the potential to result in fish injury or death. Mortality may be immediate or delayed. Handling of fish increases their stress levels and can cause a variety of injurious conditions, including reduced disease resistance, osmoregulatory problems, decreased growth, decreased reproductive capacity, and increased mortality (Kelsch and Shields 1996).

Stream diversions for instream work at road crossings would be likely to occur no more than once or twice during the life of the permit and would affect only a short reach of stream for each crossing. Dewatering for instream work, therefore, would affect a very small portion of the total stream system. The likelihood of fish being present during stream dewatering is expected to be low as most work will be conducted during recommended fish-timing windows. Likewise, for those few fish that remain in the dewatered reach of a stream after isolation measures are applied (block nets, sand bags, or other obstructions), injury and death due to handling stress and the use of seines, dip nets, and traps is believed to be rare. In most cases, the handled fish will be released shortly after their capture, minimizing stress. Depending on the number of fish that need to be relocated during each fish-salvage operation, some deaths may occur during the handling and transfer process.

While avoiding and minimizing exposure is desirable for minimization of effects, removing fish from work areas has the potential to injure or kill fish, even under Service-approved protocols. Approximately 75 percent of the fish present at the time of worksite isolation will be removed by coarse measures aimed at manually locating and removing fish from the worksite (Nielson 1998). These methods include the use of seines and other nets walked through the worksite. Fish visually observed can be hand netted and moved to stream portions outside of the worksite. Thereafter, electrofishing is used to locate and remove remaining fish. In most, if not all circumstances, capture of fish by electrofishing is attempted only after less harmful methods of fish removal have been used. The FPCHP covers the use of electrofishing for this purpose and the effects are discussed in more detail below.

Electrofishing. Electrofishing is used to move fish during instream projects that require worksite isolation to avoid and minimize exposure of fish to the effects of instream work. Example projects that might require worksite isolation include culvert replacements and stream channel relocation. After isolating and dewatering the work area, workers commonly use electroshocking to locate fish left in the isolated area, remove them to outside the isolated are, and thus minimize construction effects on those fish by eliminating exposure.

Electrofishing is also used to support monitoring and research efforts to quantify fish population abundance and other trends in selected monitoring reaches. Fish population monitoring reaches may be distributed throughout the FPHCP lands. Estimates of fish populations in these reaches may be conducted annually during certain years or may be conducted only periodically (e.g., every 10 years). Surveys may be conducted using standard multiple-pass removal electrofishing techniques, with block nets, or using modified procedures approved by the Services. Densities for each species likely would be calculated in addition to population estimates. Habitat surveys generally would be conducted concurrently.

While avoiding and minimizing exposure is desirable for minimization of effects, removing fish from work areas has the potential to result in permanent, adverse effects to fish, even under Service-approved protocols. In addition to mortality, electrofishing may cause spinal hemorrhages, fractured vertebra, spinal misalignment, and separated spinal column (Hollender and Carline 1994; Dalbey et al., 1996; Thompson et al., 1997; Kocovsky et al., 1997). Differences in injury and mortality rates may be due to the size and/or age of the fish (Habera et al., 1996; Thompson et al., 1997a). Adult fish seem most prone to these injuries. Juvenile fish, on the other hand, may only experience stress from electrofishing. (Nielsen, 1998). Fish injury rates vary due to voltage level used, experience and skill of samplers, duration of capture sequence (i.e. the amount of time taken to complete electrofishing within a sample area), and frequency of sampling through time (years) (Kocovsky et al., 1997). Sublethal effects are not always externally evident in electrofished populations; external examinations may greatly underestimate spinal injuries. Dalbey et al., (1966) indicated that only 2 percent of the captive wild rainbow trout they surveyed had externally visible deformities, but X-ray analysis used to quantify sublethal injuries after nearly one year in captivity indicated 37 percent of the population had been injured. Long-term effects from proposed electrofishing would likely include differences in growth rate and/or body condition in individual fish during variable periods of time after electrofishing (Gatz et al., 1986; Taube 1992; Dwyer and White 1995).

Regardless of the purpose, standard procedures will be followed when electrofishing is conducted to minimize injury to fish or other aquatic organisms. Only trained and experienced professionals will perform electrofishing surveys in the project area. All electrofishing will be conducted in accordance with guidelines developed by NMFS (NMFS 2000, or as they may be revised in the future), and all applicable State and Federal permits will be attained.

Hardwood Conversion. Before no-harvest zones were applied along streams, hardwood (e.g., red alder) or brush stands often replaced harvested conifers in the riparian zone, especially when natural regeneration was common practice. A recent study reported that 30 to 52 percent of the riparian forests along Westside streams currently supporting fish are dominated by red alder (Washington Hardwood Commission 2000).

Hardwoods play a variety of ecological roles in riparian forests. Red alder, for example, is a nitrogen-fixing species. Alders within a stand can contribute to the soil-nitrogen pool and may in some cases improve general tree growth. Alder are also resistant to certain tree diseases. Big-leaf maple (*Acer macrophylum*) and other hardwoods have been implicated in improved nutrient cycling in conifer forests. The easily decomposed litter of these species mixes with and hastens the decomposition of conifer litter, thus increasing the rate of nutrient cycling. Hardwood stands often support a different understory community compared to conifer stands.

Red alder is the dominant hardwood species in western Washington riparian forests, but is short-lived. Stands of alder often begin to senesce at about 60- to 80-years of age. Where riparian stands are dominated by red alder and there is little or no conifer understory, achieving DFC is likely to be delayed for many years beyond the 140-year mature stand target age. Many hardwoods, such as red alder, decay and break up relatively rapidly after falling into channels (Harmon et al., 1986; Newton et al., 1996).

Stand conversion may be employed to restore riparian management zones to more natural functional conditions for riparian and in-stream habitat. Conversion of riparian hardwood or brush stands to conifer stands is often conducted with the intent of enabling more rapid development of stands of mature conifers. Conifers, unlike hardwood sources of woody debris, provide more persistent, LWD once delivered to the stream, enabling longer in-stream function of that LWD in the creation and maintenance of fish habitat.

Generally, stand conversion from hardwood to conifer would only occur in sites that historically, naturally supported mature conifers prior to previous management. Lands that are best-suited for hardwoods will generally remain hardwood stands because they are difficult to convert physically or biologically. Such stands typically occur in western Washington. In western Washington, red alder has proliferated in stands once dominated by conifer, and conversion back to conifer is often considered desirable. In contrast, hardwoods are often a preferred species for retention in eastside riparian forests, as hardwood trees are recognized for their benefits to wildlife. Therefore, hardwood conversion is less common on the eastside than it is in western Washington.

In older hardwood stands, conversion may involve yarding. In younger stands, hardwoods may be slashed and left. Hardwood conversion often includes running chainsaws and heavy equipment. Under standard hardwood conversion rules, no conversion will occur within 50 feet of the stream. Riparian forests in channel migration zones will be maintained, thus retaining bank stability, shade, and detrital inputs.

Hardwood conversion and harvests conducted under the Forest Practices over-stocked template may include the use of equipment within the Inner Zone and as close as 14 to 30 feet from the streambank. Use of heavy equipment close to the streambank may result in soil compaction, especially if equipment must travel to the end of the management zone.

Reduction in canopy cover from hardwood removal outside the Core Zone may allow some additional sunlight to reach the stream but is unlikely to affect summer-time temperatures in the immediate reach, or increase autochthonous primary production within the stream. Stream-side shade would continue to be provided by the Core Zone. Canopy reduction or removal would increase the amount of sun reaching the ground in the Riparian Zone during the growing season and would stimulate understory vegetation. However, shading of the Riparian Zone would return relatively quickly as the canopy of retained trees closes, tall shrubs become established, and young trees grow quickly in height.

Conditions following hardwood conversion would differ depending on the level of removal. In some cases, hardwoods may be the only overstory trees and hardwood conversion would result in a stem-initiation condition with conifer seedlings. In other cases, a number of conifers may be retained and represent a variety of species and sizes. Reduction in the hardwood canopy would only result in minor increases in wind-throw vulnerability of the Core Zone as hardwoods decrease in ability to deflect wind in the winter because they lose their leaves during this time of year.

Hardwood conversions would remove a source of large wood (harvested deciduous trees) that would have been available in the short term, but would not have been very persistent once delivered. Removal of alder and planting of conifers would eventually result in conifers of key-piece size with potential to deliver to stream and to persist as large wood for extended periods of time. In the short term, when LWD is missing from adjacent stream segments, hardwoods with root wads attached may be added to the stream if equipment can do so without damaging public resources. Large wood will take longer to recruit than if alder were retained, but conifer wood will eventually provide more-persistent LWD. Thus, when hardwoods are viewed as a source of LWD supplying structural habitat creation and maintenance functions, the effect of hardwood conversion will be to remove less desirable sources of LWD that would have poorly functioned (and only for a short period of time). The removal will enable the more rapid development of

LWD sources from conifer (than would have occurred without the conversion), a more desirable source of LWD.

Hardwood conversion may result in some reduction in detrital input, especially from deciduous leaves, to the riparian zone and eventual reduction of nutrient input into the stream. Detrital inputs from hardwood and deciduous shrubs are particularly important for aquatic life (Piccolo and Wipfli 2002). The ultimate result of hardwood conversion, however, is a return to natural riparian conditions and detrital inputs.

During hardwood conversions, possible reductions in detrital inputs and LWD recruitment will be ameliorated by: (1) sources in the untreated CMZ and the no-harvest Core Zone adjacent to Type S and F streams and portions of Type Np streams; and (2) the fact that few landowners (i.e., less than one percent of all forest practices applications) have converted riparian hardwood stands to conifer stands since the current forest practices rules went into effect in January 2000. Under the proposed action, few eligible sites are likely to be converted. Given the prevalence of red alder across the action area, and the inherent patterns of riparian disturbance, alder will continue to be a significant source of allochthonous inputs.

Vegetation Control. Vegetation management is used for site preparation and to control competing vegetation in order to increase survival, growth, and health of planted stock. Vegetation control is a common practice following hardwood conversions, especially where aggressive understory vegetation exists, and may occur within the Riparian Zone. The goal is to reduce or control - not eliminate - competing vegetation. Various methods can be used. Site-specific conditions and management objectives are considered when choosing a control method. Hand slashing or cutting of unwanted vegetation, pulling or grubbing with hand tools, ground application or injection of herbicides, or a combination of these methods may be used to control competing vegetation. Mowing, tilling, disking, and plowing competing vegetation are not expected in the Riparian Zone. All noxious weed material would be disposed in a manner that would prevent its spread.

Young alder competing with conifer seedlings are often hand-slashed, while big-leaf maple coppicing (production of new shoots from stumps or roots) is usually controlled by fine stem spraying or injection with herbicides. Control of broadleaf plants often involves the use of a variety of chemicals. Regardless of application type, multiple applications may be necessary in some situations until seedlings are “free to grow,” usually a period of less than 10 years. It is important to note that chemical use is not a covered activity, and use of some of these chemicals could injure or kill covered species. Therefore, only the use of glyphosate (e.g., in the form of Rodeo®), with the least-toxic surfactants available (e.g., Agridex®) is analyzed (see below). Glyphosate applied as prescribed is not likely to kill or injure fish.

However, in this Opinion we are analyzing the application of glyphosate that is factory-formulated with no carrier other than water and only surfactants that are very low in toxicity (e.g., Agri-Dex®). We are only analyzing this combination of herbicide and surfactants because we do not have enough information about other pesticides and combinations to conduct a rational effects analysis. Many chemicals have potentially harmful by-products and the combination of chemicals and tank mixes may have potential synergistic effects. The number of potential chemicals available for use, multiplied by the potential combinations, preclude us from reasonably assessing effects to covered species. In addition, interrelated activities that are not covered activities are expected to be lawful activities. We are confident that the use of glyphosate and a surfactant such as Agri-Dex® would not result in effects that would be expected to rise to the level of take for the covered species. We cannot be equally confident of this for other chemicals and combinations of chemicals.

Herbicide Application. NMFS assumes that landowners will try to avoid the use of chemicals by careful harvest planning. For instance, some sites considered for hardwood conversion may be unsuitable due to the existing abundance of salmonberry which would likely thrive following harvest. NMFS also assumes that manual or mechanical treatments would be sufficient in most cases, but in other cases chemicals may be used to control competing vegetation resulting from hardwood conversion and other timber harvest activities within the Riparian Zone, before and after subsequent planting of conifers. This assumption is based on the fact that chemical use to control competing vegetation is a common practice especially where aggressive understory vegetation exists.

Glyphosate may be used when it has sufficient efficacy for the target plants. In order to help the efficacy of glyphosate, surfactants are used to increase the absorption of the active ingredient across the plant's surface membrane. The toxicity of surfactants and formulations are major considerations within the Riparian Zone and all steps to minimize delivery of toxic chemicals are expected to be used even if they result in a slight reduction of efficacy. Several surfactants have been approved in Washington State. We assume that only the least toxic surfactants, and those producing the least toxic break-down products, would be used. At this time, we expect that only a surfactant such as Agridex® may be used. Rodeo® and Agridex® are licensed for aquatic application. We also assume that land managers would want to maximize efficacy and minimize economic costs and therefore would avoid allowing spray to reach water surface. Although application of glyphosate directly to the aquatic environment is not addressed by the Washington Forest Practices Rules, Rodeo® and Agridex® are licensed for aquatic use.

Hardwood conversion will not occur within the first 50 feet of Type S and F streams. Forest managers would generally apply the lowest application rate consistent with the intended purpose using a low-pressure back-pack sprayer for spot treatments. When feasible, a spray hood would be used to direct chemicals at the immediate vicinity of the planted tree. All applications would be made in accordance with label instructions to ensure proper timing, correct rate of application, and appropriate application methodology. Application would not be made when rain is anticipated within 24 hours.

Spraying glyphosate following hardwood conversion will have little direct effect on covered species or on detrital inputs, and LWD recruitment to streams (Hawkes 2006, pers. Comm.). Glyphosate will be sprayed at least 50 feet from the stream and only a limited portion of the planted area would be sprayed. Because chemical application can be expensive, manual control and use of advanced planting stock would minimize the need for glyphosate use. Also, young trees are commonly planted with 12-foot spacing. If glyphosate is applied with a 3-foot spray radius (or hood), only 27 square feet, or 20 percent, of each 144 square feet will be sprayed. This 20 percent would only be applied to the subset of planted areas that required any spraying. Other areas would not be sprayed at all. Applications may need to be repeated. The use of glyphosate (e.g., Rodeo® and Agridex®), as described above, is not likely to adversely affect covered fishes.

Application of glyphosate, applied as described above, is considered an interrelated and interdependent activity. Because the application of chemicals is not a covered activity, it would be subject to the section 9 prohibition if it resulted in take of species protected under the ESA.

2.1.4.2.8 Relevance of Habitat Effects on Populations of Covered Species

As a threshold consideration, the foregoing analysis indicates that while forestry and road management activities can affect the functional processes that create and maintain the habitat types considered in this consultation, those processes in places managed under the FPHCP will have already attained a certain level function by the time practices occur there under the FPHCP prescriptions. The FPHCP prescriptions were developed to protect that existing level of function and enable increased function to develop thereafter, at the smallest scale of analysis (the scale of local operational units (harvest) or stream reaches (road management). Since the level at which these processes will function after application of FPHCP prescriptions will meet the ecological needs of covered species at this small, local scale, and will enable further improvement as adjacent regeneration harvest units mature, it follows that conditions will improve cumulatively across the affected landscape.

During consultation, Forest and Fish stakeholders suggested that NMFS needed to refine the analysis to identify populations that might be particularly vulnerable to the short term effects of FPHCP activities, despite the apparent logic underlying the threshold consideration above. The concern according to these stakeholders was that that there could arise a scenario under which acute, local effects of the action on a sub-group of certain populations could bear on the survival prospects of the entire covered species, ESU, or DPS. The North Fork and South Fork Noosack and White River spring populations of Puget Sound Chinook and Ozette Lake sockeye were identified in particular.

For the Puget Sound Chinook ESU, NMFS previously identified habitat throughout the Puget Sound Chinook ESU that has been blocked or degraded (Good et al.,2005) as one of the bases for present listing status. In general, forest practices have impacted upper tributaries, and agriculture or urbanization impacted lower tributaries and mainstem rivers. While NMFS 2005b did not attribute forest practices effects as a primary concern for any specific Puget Sound Chinook populations, Bishop and Morgan (1996) identified a variety of related habitat issues for streams in the range of this ESU similar to those that emanate from the environmental effects of forest practices. The list includes changes in flow regime (all basins), sedimentation (all basins), high temperatures (Dungeness, Elwha, Green/Duwamish, Skagit, Snohomish, and Stillaguamish rivers), streambed instability (most basins), estuarine loss (most basins), loss of large woody debris (Elwha, Snohomish, and White rivers), and loss of pool habitat (Nooksack, Snohomish, and Stillaguamish rivers), and blockage or passage problems associated with dams or other structures (Cedar, Elwha, Green/Duwamish, Snohomish, and White rivers).

Since the White River spring Chinook populations of Puget Sound Chinook were specifically identified during consultation as having an important place in the recovery considerations of that ESU (Bruce Davies, pers. comm.), NMFS reviewed the factors having a particular effect on the measures of population viability for that population. Notably, Good et al. (2005) identifies changes in flow regime and blocked habitat as the result of instream structures and dams as particularly limiting for White River spring Chinook. These are factors that are not affected by forest practices, and therefore not addressed by the FPHCP. In fact, to the extent White River spring Chinook have habitat issues related to forestry, the FPHCP prescriptions are likely to be as protective of those habitat functions for White River spring Chinook as they are for any of the covered species. Therefore, it is extremely unlikely that forest practices under the FPHCP prescriptions will effect White River spring chinook viability in any way that would influence the long term survival prospects of the Puget Sound Chinook ESU.

Unlike White River spring Chinook, the two Nooksack populations have been identified as having been affected by lost pool habitat. This environmental concern can be attributed to past forest practices under the pre-1999 and earlier forest practices rules. However, as the analysis above indicates, the FPHCP prescriptions would be protective of the pool forming functions that develop in the Nooksack River as previously harvested areas are reforested and mature to a mid-seral condition approaching their next harvest. Furthermore, riparian management prescribed by the FPHCP would reduce the effects of the next regeneration harvest in those operational units, enabling even greater development of the LWD sources that, when recruited, provide the pool forming function presently of concern for the two Nooksack populations of chinook. In addition to LWD, the improved sediment trapping function would reduce the extent of sedimentation in those water (for all populations including the North and South Fork Nooksack Chinook), and as existing deposition transports downstream, new and old-filled pools would be scoured.

Ozette Lake sockeye were specifically identified because the ESU consists fundamentally of a single population (formed of multiple spawning aggregates). As such, the concern is obviously that if effects on the single population are severe enough, the risk increases for the entire ESU. When reviewing the status of Ozette Lake sockeye, the BRT specifically identified siltation of beach spawning sites as limiting productivity of the multiple spawning aggregations of the ESU. Siltation results from the types of sedimentation identified above as typically resulting from forest practices and road management. However, at the same time, the BRT also recognized that most of the forestry in the geography containing the freshwater range of this ESU occurred in the decades after large scale decreases in the harvest numbers occurred. In 1953, only 8.7 percent of the basin had been logged, while 60 percent had been logged by 1981. Thus, logging occurred largely after the substantial decline in sockeye salmon catch in the early 1950s (Good et al., 2005). Furthermore, the BRT identified implementation of the Forest and Fish agreements (the rules that are the basis of the FPHCP prescriptions) among new activities mitigating and improving degraded habitat quality in this portion of the action area. That determination is borne out by the analysis above in that the riparian protection and road management prescriptions of the FPHCP will protect and enable continuing improvement of the processes that regulate sediment delivery throughout the action area, including the locations that deliver sediment to beaches identified as spawning locations for the Ozette Lake sockeye ESU.

2.1.5 Effects on Critical Habitat

The ESA's section 7(a)(2) obligation that Federal Agencies consult with the Services is, in part, to ensure that Federal actions are not likely to result in the destruction or adverse modification of the habitat of listed species which is determined by the Secretary to be critical. "Critical habitat" means the specific areas within the geographical area occupied by the species at the time of listing, which has physical or biological features essential to the conservation of the species and which may require special management or protection, and specific areas outside the geographical area of the listed species at the time of listing, if they are determined by the secretary to be essential for conservation of the species (16 U.S.C. 1532(5)). "Conservation" means the use of all methods necessary to bring listed species to the point that the protective measures of the ESA are no longer necessary. Critical habitat is designated for all but one of the listed ESUs (the Lower Columbia River coho ESU) addressed in the HCP and Opinion. Critical Habitat is not designated for any of the other covered species.

The proposed permit would cover a large extent of non-Federal forest in Washington State. These lands contain critical habitat that was first designated in 1993, and other critical habitat for which designation became effective on January 2, 2006. These designations are separately identified only because when each rulemaking occurred, NMFS used slightly different terminology to describe the essential features or constituent elements of critical habitat, as explained below. For ease of reading, this analysis evaluates whether the issuance of the proposed permit will influence the conservation value of critical habitat in terms of the "primary constituent elements" (PCEs) of proposed critical habitat.

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, this section relies on the statutory provisions of the ESA to complete the analysis. Therefore, regardless of the difference in terminology between the two sets of designations (1993 and 2006), the analysis determines whether the effects of the action on PCEs at the local level have any influence on the conservation value of the designated critical habitat. If the conservation value of the overall designation is adversely affected, then NMFS would determine that the action probably adversely modifies or destroys critical habitat. If the proposed action would adversely modify or destroy critical habitat, then NMFS must provide a reasonable and prudent alternative, which would, among other things, avoid such destruction or adverse modification.

2.1.5.1 Critical Habitat Originally Designated in 1993

Final critical habitat designations for the Snake River sockeye, spring/summer Chinook, and fall-run Chinook ESUs were effective on December 28, 1993 (58 FR 68543). The spatial features of designated critical habitat for Snake River sockeye, spring/summer Chinook, and fall-run Chinook ESUs are: the water, the waterway bottom, and the adjacent riparian zone of specified lakes and river reaches in hydrologic units presently or historically accessible to listed Snake River salmon (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams). Adjacent riparian zones are defined as those areas within a horizontal distance of 300 feet (91.4 m) from the normal line of high water of a stream channel (600 feet or 182.8 m, when both sides of the stream channel are included) or from the shoreline of a standing body of water (50 CFR 226.205).

The four components of essential Snake River salmon habitat within designated critical habitat are: (1) spawning and juvenile rearing areas, (2) juvenile migration corridors, (3) areas for growth and development to adulthood, and (4) adult migration corridors (December 28, 1993, 58 CFR 68544).

The essential features of juvenile spawning and rearing areas, as well as juvenile migration corridors are 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. The essential features of adult migration are the same, excluding food.

The essential features of sockeye nursery areas are adequate (1) spawning gravel, (2) water quality, (3) water quantity, (4) water temperature, (5) food, (6) riparian vegetation, and (7) access. These essential features differ somewhat from those of other salmonids because of differing life history expression.

To avoid confusion in the rest of this section, "essential features" of critical habitat, together with PCEs, are referred to as "PCEs" of critical habitat.

2.1.5.2 Critical Habitat Designation Effective January 2, 2006

In September, 2005, NMFS designated critical habitat for the following ESUs and DPSs: Puget Sound Chinook; Lower Columbia River Chinook; Upper Willamette River Chinook ; Upper Columbia River spring-run Chinook; Hood Canal summer-run chum; Columbia River chum; Ozette Lake sockeye; Upper Columbia River steelhead; Snake River Basin steelhead; Middle Columbia River steelhead`; Lower Columbia River steelhead; and Upper Willamette River steelhead (70 FR 52630).

Areas outside the geographical area presently occupied by a species can be designated as critical habitat only when a designation limited to its present range would be inadequate to conserve the species (50 CFR 424.12). Unoccupied habitat is proposed for designation only for the Hood Canal summer run chum salmon ESU; approximately 8 miles (12.9 km) of unoccupied (but historically utilized) stream reaches are essential for the conservation of this ESU.

Critical habitat designated for Puget Sound Chinook; Lower Columbia River Chinook; Upper Willamette River Chinook ; Upper Columbia River spring-run Chinook; Hood Canal summer-run chum; Columbia River chum; Ozette Lake sockeye; Upper Columbia River steelhead; Snake River Basin steelhead; Middle Columbia River steelhead; Lower Columbia River steelhead; Upper Willamette River steelhead DPSs includes the following: Stream channels to their lateral extent as defined by OHWM, lakes to the OHWM, estuarine and marine nearshore to extreme high water where they contain PCEs (sites/ habitat components supporting one lifestage or more).

2.1.5.2.1 Primary Constituent Elements. The regulations at 50 CFR 424.12(b) specify that the "known primary constituent elements shall be listed with the critical habitat description." The PCEs essential for the conservation of the covered salmonids are those sites and habitat components that support one or more life stages, including:

(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;

(2) Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage supporting juvenile development; and (iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

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

(4) Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

(5) Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.

(6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

2.1.5.3 Framework for Critical Habitat Analysis

As stated in the "approach" section above, NMFS assumes that listed salmonids are limited by both the quantity and quality of habitat in the action area. Critical habitat is likely to be affected throughout the action area. At the same time, many activities will occur in critical habitat without adversely affecting the value of PCEs of critical habitat at the operational unit scale, thus not diminishing the conservation value of that critical habitat. This analysis will determine whether there are any instances where the habitat affects of the proposed action (as they occur locally) are important enough to the overall designation of critical habitat to influence the value of that designated critical habitat to the conservation of the affected ESU.

As recommended in the Novermber 7, 2005 NMFS guidance on conducting critical habitat analysis, this assessment begins in the Status of Critical Habitat section where the overall critical habitat designations are described, including the PCEs of critical habitat. The Environmental Baseline section discusses the present condition of those PCEs through the description of predominating environmental conditions in several, geographically defined areas of Washington State that comprise the action area.

The effects of the proposed action on critical habitat described in this section consist of the direct and indirect effects of the action and those interrelated and interdependent actions, on the PCEs. Effects are the changes to the natural processes and conditions as they constitute PCEs (i.e., substrate and sediment levels, water quality conditions, flow, stream temperatures, physical habitat elements, channel condition, chemicals and nutrients, riparian vegetation, habitat accessibility), caused by activities that would occur as described in the FPHCP.

This analysis tracks the framework used for the description of effects above in that, for each watershed feature or process, the analysis describes: the activity that could influence the watershed process or feature; the likely change in habitat function caused by the activity (as addressed by prescriptions in the proposed HCP) at the operational unit scale; and the importance of that change for the conservation value for the conservation of the entire designation.

To assess the importance of any changes in critical habitat function, and thus to make a determination regarding whether the proposed action would adversely modify or destroy critical habitat, the assessment must aggregate the described effects. That means the assessment must discuss whether with the proposed action, critical habitat would remain functional (or retain the present ability for the PCEs to become functionally established) to serve the intended conservation role for the ESUs for which critical habitat is designated.

As described above, the proposed HCP prescribes measures for timber harvest activities (harvesting, bucking, felling, and yarding) in the riparian zone and road maintenance and abandonment through out the action area, and requires identification and protection of unstable slopes and other sensitive sites. The environmental baseline for these places is variable throughout the action area, based mainly on when the most recent management occurred, the regulatory regime governing State forest practices at the time that management occurred, and any site-specific provisions applied when management occurred. Places having undergone forest management operations under past regulatory regimes that were less protective of salmonid habitat functional conditions, are likely to have less functional present habitat conditions, unless those past practices are remote enough for function to have passively returned. As identified and described in the preceding effects section, the effects of the types of forestry activities addressed by the proposed FPHCP can be grouped into effects on certain watershed processes that affect the functional condition of aquatic habitat. These groups include stream shade, large woody debris, detrital inputs, and sediment capture.

2.1.5.3.1 Effects on PCEs of Critical Habitat.

Stream Shade. The effects of past timber harvest management in riparian areas would have included decreased shade. Decreased shade can affect water temperature leading to increased water temperatures where shade is the dominant factor on temperature regulation. Water temperature is part of the water quality element of the PCEs of critical habitat for all freshwater lifestages of salmon including spawning, rearing, and migrating. Smaller streams such as those higher in the watershed, including type N streams, are more vulnerable to temperature, but also recover more quickly after perturbations. Reduced shade has less effect on stream temperature in larger waters, but those waters require a greater extent of vegetative recovery before streams temperatures respond in kind.

Under the environmental baseline, places subject to forest management operations under past regulatory regimes that were less protective of salmonid habitat functional conditions, are likely to have less functional water temperature for those life history expressions. Places where those practices occurred farther in the past are more likely to have restored to more functional present conditions, just from the passage of time.

The FPHCP addresses the effects of riparian harvest on shade (and hence, on water temperature) by limiting the extent of riparian harvest within certain distances from the affected water. As stated earlier in the Effects section of this Opinion, harvest under the proposed HCP would retain substantially more shade-providing, temperature protecting, forest vegetation than occurred under practices that led to the condition of the environmental baseline, especially in fish-bearing (type S or F) waters. The HCP prescribes less vegetation retention for non-fish bearing waters, but still more than the past requirements that led to existing baseline conditions. Harvest under these requirements would not prevent, and therefore would be adequate to provide for, the restoration of functional water quality condition in downstream fish-bearing areas.

These effects on stream shade (and on water temperature) would be important in the North Puget Sound WRIAs, Lower Columbia River WRIAs, and Southwest Washington WRIAs where water temperature has been generally adversely affected by past vegetation removal, affecting freshwater thermal refugia in larger waters. Improved protection of water temperature in places where this element presently functions less well for spawning, rearing, and migrating salmonids would enable functional improvement after riparian harvest.

Large Woody Debris Recruitment. The effects of past timber harvest management in riparian areas would have included decreased large woody debris recruitment. With less large wood recruiting to streams, watersheds can experience decreased habitat complexity, simplified channel characteristics, and increased water velocities during peak flow. Structural complexity supports the rearing and migrating behaviors characterizing two of the three freshwater PCEs of critical habitat.

Under the environmental baseline, places subject to forest management operations under past regulatory regimes that were less protective of salmonid habitat functional conditions, are likely to have less functional large woody debris or standing riparian conditions from which to recruit large woody debris. Past practices have included the requirement of removing large wood from streams. Furthermore, while riparian vegetation retention requirements have grown progressively more protective of riparian functions through the years, they were once non-existent and were still very modest in the recent past. As a result, most Washington WRIAs presently lack large woody debris at levels that meet the functional role necessary to maintain channel and other structural complexity for the rearing and migrating PCEs.

The FPHCP addresses the effects of riparian harvest on large woody debris by limiting the extent of riparian harvest within certain distances from the affected water. As stated earlier in the Effects section of this Opinion, harvest under the proposed HCP would retain substantially more forest vegetation than occurred under practices that lead to the condition of the environmental baseline, especially in fish-bearing (type S or F) waters. The HCP prescribes less vegetation retention for non-fish bearing waters, but still more than the past requirements that lead to existing baseline conditions. Harvest under these requirements would not prevent, and therefore would be adequate to provide for the restoration of functional water quality condition in downstream fish-bearing areas.

Detrital Inputs. Leaf litter, needles, and other such material falling into streams from riparian vegetation comprise the food sources for the organisms on which salmonids feed in the freshwater rearing and migrating life histories. As such they are components of two of the three salmonid freshwater PCEs. Nutrients from a variety of sources increase in the first few years following logging (Hicks et al., 1991). Some of this increase is related to increased sunlight on the stream, and increases in primary productivity can enable increases in individual juvenile salmonid growth. However, post-logging nutrient increases have not been closely linked to overall salmonid production (Hicks et al., 1991). In contrast, riparian harvest reduces the extent of leaf and litter sources near streams and this condition is notable in the environmental baseline throughout the action area.

The FPHCP addresses conservation of nutrient input sources in two ways. First, the riparian vegetation retention requirements will conserve far more streamside vegetation (and hence, sources of leaf and needle litter) than did operations under the regulatory regimes that lead to existing baseline conditions. Second, western Washington landowners have the option of converting hardwood-dominated riparian stands to conifer-dominated stands in the Inner Zone of the RMZ to increase sources of large woody debris recruitment.

While hardwood conversions could reduce detrital inputs from alder, these losses would be ameliorated by sources in the untreated CMZ and the 50-foot no-harvest Core Zone adjacent to Type S and F streams and portions of Type Np streams. Furthermore, few landowners (less than one percent of all forest practices applications) have converted riparian hardwood stands to conifer stands since that option first arose in January 2000. Therefore, sources of detrital inputs would increase under the FPHCP.

Since the existing amount of detrital input will remain high and continue to increase under the

FPHCP, benthic invertebrate production will remain diverse, even in recently harvested riparian areas. Therefore, even in parts of the action area where detrital sources are presently less functional, the amount of leaf and needle delivery is expected to improve as riparian stands grow into older mixed hardwoods and conifers. Retained streamside vegetation will, over time, provide nutrient input levels that meet the biological requirements of salmonids.

Sediment Capture. Sediment suspended in streams affects water quality, interfering with feeding and predator avoidance for juveniles and migration behavior for adults. When suspended sediment settles on the stream bed, water quality improves; but depending on the location of deposition, it can alter stream bed characteristics. These changes can include decreased number and quality of pools in forced-step pool streams, decreased sediment-storage capacity of such streams, and embedded spawning substrate downstream in fishbearing water. Water quality is a component of all six salmonid PCEs. The effects of the proposed action on the water quality element of the three freshwater PCEs are most relevant for the analysis of this proposed action.

As water moves down through a watershed from type N streams lacking large woody to type F streams, the habitat effects can include higher stream velocity. Higher stream velocities will flush sediment downstream to type F streams, filling and raising the level of the streambed in the type F streams, forcing the stream energy to be absorbed at the stream banks. In turn, these effects lead to broader, shallower streams that can be less supportive of the salmonid freshwater life histories.

Sediment delivery to streams can reduce the diversity and densities of the food sources of covered fish species. While sediment remains suspended, turbid water affects light penetration which, in turn, affects the ability of covered fish to forage. When turbidity levels are persistently elevated, juvenile growth rates might be suppressed due to the poor feeding conditions. Turbid water in high enough concentrations 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.

The FPHCP requires several prescriptive approaches to address the processes that deliver sediment to streams, including trees retained in riparian buffers; unstable slope identification and protection; road construction, maintenance, and abandonment management, including emphasis on water crossings to improve fish passage, flood passage, and wood passage; equipment exclusion; and best management practices. The results of these approaches would be first to reduce the likelihood of sediment delivery to streams, and then to ensure that only a small amount of sediment is delivered to streams, as described in more detail in the habitat effects discussion in the preceding section.

Riparian buffers would minimize the amount of sediment delivered from riparian and upland areas by providing physical barriers to trap sediments moving overland, as well as dissipating the sediment-moving effects of falling raindrops. Harvest prescriptions on unstable slopes (and other sensitive sites) would reduce the likelihood of mass wasting as well as the extent of sediment exposed to erosion. Road management measures would reduce the likelihood and extent of debris slides from road and water crossing failures, and minimize the generation of sediment from surface erosion. Sediment from these sources cannot be eliminated, but the measures of the FPHCP should result in conditions improved from those that have resulted from practices under previous regulatory regimes and should not impair the conservation value of the habitat.

2.1.5.3.2 Summary of the Effect of Forestry Activities on PCEs. Timber harvest reduces vegetation in and near riparian areas, affecting shade (and thus, water temperature), the extent of large wood available for recruitment to streams (affecting structural components of instream habitat), detrital inputs (affecting salmonid food sources), and sediment capture (affecting water quality while suspended and substrate when deposited). Road construction and maintenance enables erosional processes that also deliver sediment to streams. All of these effects influence the ability of affected areas to support spawning, incubation, larval development, juvenile growth and mobility, and adult mobility.

While timber harvest practices and activities related to forest roads would continue under the FPHCP with the effects described above, the FPHCP would alter the location and intensity of forest practices, which will also affect designated critical habitat. The history of forest practices in Washington State leaves an environmental baseline condition in which many riparian areas consist of post-harvest regrowth, containing trees of 50 years or less. Many riparian areas affected by past harvest have only a very narrow band of intact vegetation next to the streams. The FPHCP prescribes more trees retained in wider buffers, in more places, with less possible alteration within the buffers. Operation under these prescriptions would improve riparian conditions for a significant amount of critical habitat. Specifically, these prescriptions would increase shade, detrital input, and, eventually, the availability of large wood in freshwater areas. These improvements would increase forage and cover, and decrease water temperatures, all of which improve PCEs, particularly for survival, growth, and maturation, of juvenile salmonids.

The types of effects described above (reduced riparian vegetation, spikes in sediment and turbidity) also occur under natural conditions, forcing stream velocity changes, thalweg realignment, and aggradation or degradation of stream beds, among other things. When these changes are part of a natural rate of change and not triggered by anthropogenic causes, they are considered part of the habitat forming processes that salmonids are adapted to, and need to thrive. Thus, a factor to consider in evaluating the degree or significance of these changes is to determine if the rate of change caused by timber practices is accelerated beyond that which salmonids can respond to successfully. In this case, the changes, though they may be widespread over the critical habitat of the ESUs are at a frequency for any given watershed that they are not expected to increase the rate of systemic habitat change outside of the normal rate of variation, and thus they should not diminish the ability of salmonids to respond to the changes in their environments. Thus, the habitat effects of the FPHCP should not impair the conservation value of the habitat at the operational unit scale.

2.1.6 Cumulative Effects

When making determinations regarding whether or not a proposed action will jeopardize species or adversely modify or destroy critical habitat, NMFS also considers the cumulative effects of other activities in the action area. The joint ESA regulations define cumulative effects as those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02).

The State, Tribal, and local government actions that could contribute to cumulative effects will likely occur under existing legislation, administrative rules or policy initiatives. Government and private actions could include changes in land and water uses, including ownership and intensity, any of which could affect listed species or their habitat. Government actions are subject to political, legislative and fiscal uncertainties. These realities, added to the geographic scope of the action area, which encompasses numerous government entities exercising various authorities and the many private land holdings, make any analysis of cumulative effects difficult and somewhat speculative. This section identifies representative actions that, based on currently available information, are reasonably certain to occur, and could have negative or beneficial effects on aquatic species. The reasonably foreseeable future probably consists of all or a portion of the 50-year term of the FPHCP. To the extent practicable, the analysis identifies existing planned actions, and relevant goals and objectives of these state and local government, tribal, and private entities.

2.1.6.1 Landownership and Use

Restrictions of forestland use, and in particular RMZ restrictions, can affect the desire of forestland owners to continue operation of their ownership as commercial forest. As a result, changed desire can influence the rate that such land is converted to other uses. Such other uses could have similar or highly divergent influences on watershed processes as forestry operations depending on the use and location of the affected ground.

While these forestry prescriptions could affect land use conversion to some degree, regulatory limits on conversion are believed especially important to small forest landowners in western Washington where population growth rates and development pressures are high (WDNR 1998). Many areas of non-industrial private forestlands in Washington were converted from primary forestland to non-primary forest use (e.g., residential development) between 1979 and 1989 at a rate of almost 100 acres per day (WDNR 1998). In comparison to past conversion rates, the rate of forestland conversion would probably remain the same or increase under the FPHCP's forest practices rules, especially in urban growth areas in western Washington. Throughout the action area as a whole however, the rate of increase will be insignificant because small landowner compensation programs would be funded under the FPHCP, and all forest landowners will be afforded substantially more regulatory certainty than exists now or in the past.

In western Washington, about four percent of the land base is presently residentially or commercially zoned or developed, and five percent is agricultural. Most of these uses occur along the lower reaches of streams, in the lower portions of watersheds, in areas that once were the most productive forestlands. Therefore, the overall contribution of the environmental conditions resulting from these uses on aquatic habitats is likely greater than their relative area.

Potential future LWD recruitment is substantially lower in residential, urban, and agricultural landscapes than it is in managed forestlands. The natural fluctuation in peak and base stream flow is accentuated in residential, urban, and agricultural settings, relative to conditions in forest land. In increasingly deforested places, peak stream flows are likely to increase over time from paving, reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, and filling and other loss of wetlands. Combined with increased peak flows, groundwater withdrawal could decrease surface base flows during the dry season (WSCC 2003). These lower basin areas, especially along portions of Puget Sound, where the intensity of both urban and agricultural development has been relatively high, have a great influence, typically much more so than forestry, on streams and the aquatic environment. These environmental results will likely continue in the action area, making adverse cumulative effects on aquatic resources, regardless of whether or not NMFS issues the proposed permit.

Land use practices on the eastside differ from the western Washington, but can also affect aquatic habitat. Overall, 26 percent of the eastside action area is designated as agriculture, 10 percent grasslands, and 25 percent scrublands, with a small portion (about one percent), residentially or commercially zoned or developed. The major land use practices include the historical conversion of low-lying areas within river valleys to agricultural lands and a high level of water diversion for irrigation. These practices will be mostly maintained into the future over much of the landscape, with concomitant cumulative contribution to effects on aquatic habitat and species in the action area.

2.1.6.2 Wildfire and Suppression Activity

During the past 10 years, an undetermined number and acres of fires have occurred in the action area. Fires and fire suppression activities are likely to continue into the future with no change from past occurrences and results in the environment. Typically, fires increase available LWD (WSCC 2003). However, an undetermined amount of suitable habitat for salmonids may be removed or modified by removing or modifying vegetation for firebreaks or backfires. Furthermore, other habitat functions or watershed processes can be disrupted by fire including slope and bank stability, sediment capture, shade, and detrital contribution.

2.1.6.3 Gravel Mining, Quarrying, and Processing

Floodplain and upland quarrying and associated gravel processing will continue to be conducted by non-Federal parties within the action area. The effects of quarries and rock mines on aquatic resources in the action area depend on the type of mining, the size of the quarry or mine, and distance from streams and rivers. Rock mining can cause increased sedimentation, accelerated erosion, increased streambank and streambed instability, and changes to substrate. Surface mining could result in soil compaction and loss of the vegetative cover and humic layer, thereby increasing surface runoff. Mining could 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 quarries and rock mines depend on several variables, the effects of quarries and other commercial rock operations within the action area on salmonids are unknown. Commercial rock quarrying will continue to be under the regulation of the DNR and individual counties.

2.1.6.4 Habitat Restoration

The focus of stream restoration will gradually shift toward more effective restoration actions as monitoring information accumulates on past projects. The state has various strategies and programs designed to improve the habitat of listed species and assist in recovery planning, including the Salmon Recovery Planning Act. Other restoration programs funded, permitted, or carried out by the Federal Government are not considered in cumulative effects.

In-stream and riparian restoration activities typically cause temporary effects on the quality of fish habitat, during construction. These effects include increases in turbidity, altered channel dynamics and stability, and temporary isolation of work areas displacing salmonids. Properly constructed stream restoration projects are likely to increase habitat complexity, stabilize channels and streambanks, increase spawning gravels, decrease sedimentation, and increase shade and cover for salmonids. The number or locations where restoration projects will be completed is unknown and difficult if not impossible to predict. Therefore, while the general effects of such work can be described, the precise contribution of the effects of these projects to overall cumulative effects cannot be predicted.

The amount of upslope restoration projects will increase. 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. Furthermore, the State is likely to engage in actions related to restoration of habitat quality through related natural resource law, such as programs delegated to the state through the Clean Water Act. For example, the state is developing a water quality improvement scheme through the development of Total Maximum Daily Loads (TMDLs).

2.1.6.5 Agriculture

Agricultural activities in the action area include grazing, dairy farming, and crop cultivation. Converting forestland to agricultural uses alters riparian vegetation in river valleys, leaving few or no riparian trees. Alder, canary grass, and blackberries, which often invade disturbed riparian areas, provide less shade and little or no LWD recruitment, even if present in the typically thin bands of riparian vegetation in agricultural land. Existing riparian conditions in all agricultural land throughout the action area are likely to persist into the future, for the term of the proposed permit.

Lower stream reach diking to reduce flooding is common in agricultural lands, and has historically caused a significant loss of secondary channels in major valley floodplains. Confined channels create high-energy peak flow events that remove smaller substrates and LWD, a condition likely to persist into the future in any diked system. The loss of side-channels, oxbow lakes, and backwater habitats in the action area will continue to reduce juvenile salmonid rearing and refuge habitat in diked systems.

Crop conversion (from one crop to another) can have environmental effects on streams that can either benefit or degrade habitat function. For example, pasture crops are increasingly likely to be converted to intensively managed tree fruits Washington State in response to market pressure. On the one hand, tree fruits require more intensive applications of pesticides than pasture land requires. On the other hand, tree fruits require less intensive applications of fertilizer. Because the effects of crop conversions depend on several variables, the effects of these conversions within the action area on covered species are noted here, but their contribution to cumulative effects is unknown and probably cannot be determined.

Dampening the range of possible beneficial and detrimental effects of agricultural practices is the state-wide trend of converting farmland to other uses. Loss of farmland is occurring because of (a) an increasing demand for residential and commercial development as the population of the state grows, and (b) a decreasing demand for agricultural lands as farm productivity increases (USDA NASS 2005). The effects of converting farmland to residential and urban development is discussed below.

2.1.6.6 Residential and Urban Development

Economic diversification has contributed to population growth and movement in the state, a trend likely to continue for the foreseeable future. By the year 2030, Washington State is projected to have a population of 8,624,801 people; an increase of 46.3 percent (2,730,680 residents) since 2000. Most of this growth will occur at existing population centers and along existing transportation routes. At the same time, population growth further from transportation corridors, consisting of retiree migration and telecommuting, will continue to occur (WOFM 2005). Such population trends will place greater demands in the action area for electricity, water, and buildable land; and will increase the need for transportation, communication and other infrastructure development. Once development and associated infrastructure (roads, drainage, etc.) are established, the impacts to aquatic species are expected to be permanent.

The effects of new infrastructure in the environment on aquatic resources includes loss of riparian vegetation, changes to channel morphology and dynamics, altered watershed hydrology (increased storm runoff and concomitant increased peak flows), increased sediment loading, increased armoring of estuarine and marine shorelines to protect private property, elevated water temperatures where shade-providing canopy is removed, and increased water withdrawal for municipal uses (leading to decreased base flows). Furthermore, construction in floodplains and similarly environmentally vulnerable areas has (and will likely continue to) led to dike and levee construction and perhaps the removal of LWD to protect that construction from flooding. The overall effect is likely to be negative, unless carefully planned for and mitigated.

Washington’s Growth Management Act was enacted to help communities plan for growth and address growth impacts on the natural environment. Most Growth Management Act counties have enacted critical area ordinances that impose a variety of restrictions on development. These critical areas ordinances, while having variable environmental protection value, should continue to address the types of issues described above as they have in the past.

Local governments are faced with similar but more direct pressures from population growth and movement. There are demands for intensified development in rural areas as well as increased demands for water, municipal infrastructure and other resources. The reaction of local governments to such pressures is difficult to assess without certainty in policy and funding. In the past, local governments in the action area generally accommodated additional growth in ways that ignored fish habitat, which often resulted in adverse effects. Also there has been little consistency among local governments in dealing with land use and environmental issues so that any positive effects from local government actions on listed species and their habitat are likely to be local and scattered throughout the action area.

Some local governments are considering ordinances to address aquatic and fish habitat health impacts from different land uses. Clark County, for example, is developing a comprehensive program, which, if submitted to NMFS, might qualify for a limit under NMFS' ESA section 4(d) rule which is designed to conserve listed species. Local governments also can participate in regional watershed health and salmon recovery programs, although political will and funding will determine participation and therefore the effect of such actions on listed species. Overall, without comprehensive and cohesive beneficial programs and the sustained application of such programs, it is likely that local actions will not have measurable positive effects on listed species and their habitat, but might even contribute to further degradation.

2.1.6.7 Recreation, including Hiking, Camping, Fishing, and Hunting

Expected recreation impacts to covered species 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 next to watercourses can impair water quality by elevating coliform bacteria and nutrients in streams. Impacts to the habitat of covered species are expected to be localized, mild to moderate, and temporary. Fishing within the action area is expected to continue subject to WDFW regulations. The level of take of covered species within the action area from angling is unknown, but is expected to remain at current levels.

2.1.6.8 Water Withdrawals

An unknown number of permanent and temporary water withdrawal facilities exist within the action area. These include diversions for urban, agricultural, commercial, and residential use. As urban and residential growth rates increase within the action area, the number of diversions and amount of water diverted are also expected to increase. Partially offsetting the increases from urbanization, reductions in farmland acreage and increased efficiencies might result in fewer diversions and less volume of water diverted for irrigation. Potential effects to salmonids of substantial water diversions are expected to include entrapment and impingement of younger salmonid life stages; 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. Water withdrawals, in conjunction with timber harvest, have been implicated in the degradation of habitat quality, caused by the build-up of sediments in estuaries (Jay and Simenstand 1996).

2.1.6.9 Chemical Use

NMFS anticipates that chemicals such as pesticides, herbicides, fertilizers, and fire retardants will continue to be used within the action area. As noted above, conversions of agricultural land from pasture to tree fruits can result in increased use of pesticides. 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 Environmental Baseline section of this Opinion.

2.1.6.10 Tribal Actions

Treaty Indian tribes are co-managers of the fishery resource and promulgate their own harvest regulations and influence the regulations that affect others. Tribal governments are likely to continue to participate in cooperative efforts involving watershed and basin planning designed to improve fish habitat. The previous comments related to growth impacts apply also to Tribal government actions. Tribal governments will need to apply comprehensive and beneficial natural resource programs to areas under their jurisdiction to produce measurable positive effects for listed species and their habitat.

2.1.6.11 Local Recovery Planning

In Washington State, groups of non-Federal entities are collaborating in salmon recovery planning a variety of geographic regions. NMFS approach to Endangered Species Act salmon recovery planning in NMFS' Northwest Region is to support local efforts, many at the watershed and subbasin geographic scale. While NMFS is responsible for adopting recovery plans, the likelihood of success increases where they are developed by the entities that have the responsibility and authority to implement recovery actions. Local development includes participation and input from federal, tribal, state, and local government agencies, and other stakeholders. Final recovery plans will include a number of components, including habitat improvement.

NMFS has identified four geographic recovery areas or "domains" in Washington State. Within these domains, planning groups oriented by watershed or subbasin have been preparing multi-species recovery plans for anadromous salmonids. The domains are: Puget Sound, Willamette/Lower Columbia; Upper/Middle Columbia, and Snake River. To date, the Puget Sound Domain and the Willamette/Lower Columbia Domain have made the most progress.

Puget Sound. On June 30, 2005, the Shared Strategy for Puget Sound presented its locally developed recovery plan (Shared Strategy Plan) to NMFS. The Shared Strategy is a nonprofit organization founded in 1999 to coordinate recovery planning for Puget Sound salmonids. It includes representatives of Federal, state, tribal, and local governments, business, agriculture and forestry industries, conservation and environmental groups, and local watershed planning groups. The Shared Strategy Plan is based on individual watershed recovery plans put together by groups and local governments in 14 watershed planning areas (December 27, 2005, 70 FR 76446). These groups and governments are participating in order to identify actions to recover salmon, and obtain the commitments needed to achieve them. They are also developing the technical content and implementation structure of their local recovery chapter.

Starting in summer 2004 they began work with other watersheds and stakeholders in the Puget Sound to integrate science and social policy into the regional recovery plan. The regional consensus process ensures the plan ultimately reflects local needs and priorities while meeting ESA requirements. Since the existing 22 independent Puget Sound Chinook salmon populations are currently at high risk of extinction, the short-term goal is to improve conditions for all the populations and to get on a trajectory toward recovery early in implementation. Additional goals in this timeframe include implementing and evaluating the set of short-term strategies and priority actions identified; gaining a preliminary view of the status and trends of important recovery indicators; and making mid-course corrections as needed. In ten years, watershed and regional leaders will put forward the next set of strategies and actions toward achieving the long-term goal. Meanwhile, early action habitat protection and restoration projects are underway all over the Sound, as are improvements in harvest and hatchery management practices.

NMFS' intent is to use the Shared Strategy Plan to guide and prioritize Federal recovery actions in the ESU, and to ultimately adopt the Shared Strategy Plan as a final ESA recovery plan for the ESU.

Lower Columbia River. The Willamette/Lower Columbia recovery domain includes the Willamette River basin and all Columbia River tributaries from Hood River downstream in Oregon and from the White Salmon River downstream in Washington. The domain contains six populations listed under the Endangered Species Act: lower Columbia River Chinook, lower Columbia River steelhead, Columbia River chum, upper Willamette River Chinook, upper Willamette River steelhead, lower Columbia River coho.

This planning area includes two states, 28 cities, 14 port districts, and substantial areas of agricultural and forest use, including both public and private ownership. This domain includes major urban centers such as the cities of Portland, Oregon, and Vancouver, Washington, and portions of the Gifford Pinchot, Mt. Hood, and Willamette National Forests, and major hydropower or flood control facilities on a number of Columbia River tributaries, including the Willamette, Clackamas, Cowlitz, and Lewis rivers.

Within this domain, the Lower Columbia Fish Recovery Board (LCFRB) leads the collaborative salmonid recovery planning effort in the Lower Columbia River region of Washington State. The collaboration includes federal, state, tribal, local governments, and the public throughout the region. The process integrates several different planning efforts into a single regional planning process: ESA recovery planning, Northwest Power Planning Council subbasin planning, state salmon recovery planning, and state watershed planning.

The LCFRB developed a recovery plan through its locally led effort in southwest Washington.

This plan addresses the Washington portion of the lower Columbia Chinook and Columbia River chum ESUs, and the lower Columbia steelhead DPS. It includes recovery goals, a comprehensive assessment of threats and limiting factors, and specific actions (including habitat actions) needed for recovery.

2.1.6.12 Harvest (Fisheries)

For the near term, it is reasonable to expect that harvest impacts will be similar to current levels described in section 2.1.3.5. Provisions of the Pacific Salmon Treaty that relate to management of Chinook and coho fisheries in particular will be in place through 2008. Fisheries managed under the jurisdiction of the PFMC are subject to long-term biological opinions that are in place until changed. Fisheries in the mainstem Columbia River will be managed subject to the *U.S. v Oregon* Interim Management Agreement through at least 2007. Puget Sound Chinook will be managed under the Puget Sound Chinook Harvest Management Plan through 2009. If and how these fisheries will change thereafter is unclear. The existing fishery regimes have developed over the years since the first listings in the Columbia River Basin in 1991, and include substantial reductions in fisheries considered necessary to comply with ESA requirements to date. It is reasonable to expect that fishery management provisions will continue to evolve in response to new information including recommendation developed through the recovery planning process. But it is not possible to predict the direction or magnitude of change for any particular ESU. Given these uncertainties, if it is necessary for planning or analysis purposes to make assumptions about harvest impacts in the future, the most reasonable assumption is that future harvest impacts will be similar to current levels.

2.1.6.13 Climate

Recent precipitation patterns in the Pacific Northwest appear to be changing from historical patterns. Depending on the region, more or less precipitation is occurring, and the seasons of precipitation are shifting (Mote et al., 2003). Researchers have projected the Cascade Mountain (Oregon and Washington) snowpack to decrease by as much as 60 percent based on changes occurring in the snowpack since the 1950s (NMFS and USFWS 2005). The decrease in snowpack could significantly decrease summer stream discharges. Over the last 100 years in the Northern Hemisphere, scientists have measured a general air temperature increase of less than 1.0 degree Celsius superimposed on the natural variability of climate (Diaz and Bradley 1995; Mote et al., 2003). However, there is no evidence that the effect of slight variations in climate on stream temperatures would be equal to or greater than the documented effects that land-use impacts have had on stream temperatures (IMST 2004).

2.1.6.14 Summary of Cumulative Effects

Non-Federal actions are likely to continue affecting covered species. The cumulative effects in the action area are difficult to analyze. Considering the geographic landscape, the political variation in the action area, the uncertainties associated with government and private actions, and the changing economies of the region. Whether these effects will increase or decrease is a matter of speculation; however, based on the trends identified in this section, the adverse cumulative effects are likely to increase. Although state, tribal, and local governments have developed plans and initiatives to benefit listed fish, they must be applied and sustained in a comprehensive way before NMFS can consider them "reasonably foreseeable" in its analysis of cumulative effects.

2.1.7 Integration and Synthesis

NMFS proposes to issue an ESA section 10(a)(1)(B) ITP. In applying for the ITP, the State of Washington (through its DNR), prepared and submitted the FPHCP. The ITP would cover take from certain otherwise lawful forestry activities (timber and roads management), regulated by the applicant on non-Federal land in the Action Area. In effect, the FPHCP consists of an assemblage of the applicant's existing regulatory regime in effect since January 2000, combined with programs to advance the present state of knowledge, and subsequent changes to the regulatory regime in response to advances in knowledge as to the environmental results of these practices.

For this consultation, identifying and analyzing the effects of the proposed action involved predicting the effects of timber harvest in mid-seral-aged stands under the FPHCP riparian and other related forest management prescriptions. In addition, the analysis considered the effects of other prescribed non-harvest forestry activities including road maintenance, construction, and road-stream crossing replacement. The analysis then assessed the results of practices as prescribed in the FPHCP for their effects on the processes that create and maintain riparian and aquatic habitat for covered species. Knowing the biological requirements of the covered species, NMFS assessed whether the ecological results practices under the FPHCP prescriptions would render post-practices conditions meeting the biological requirements of individuals animals, at the smallest scale of analysis, the individual practical unit (harvest unit or reach length for other practices).

In gauging the effects of management under the FPHCP prescriptions, NMFS considered the condition of the environmental baseline and what that baseline would consist of when practices occurred throughout the proposed ITP term. The condition of the Environmental Baseline existing at the time of this consultation is a reflection of historic forestry practices in the Action Area, conducted for the past 50 to 100 years under a variety of regulatory regimes, including little or no regulation at all. Therefore, there are presently places in the action where past harvests removed most if not all of the riparian vegetation that support the habitat functional processes that make and create habitat. As those harvested areas are planted or naturally grow new forest, those habitat functional processes return. Some function return gradually, like sources of recruitable LWD, and the pools and other physical in-stream characteristics and processes LWD enables. Others return more rapidly, such as the shade which keeps cool water cool and enables warm water to cool down.

The FPHCP prescriptions were derived by considering the environmental results of forestry practices on those functional processes affected by altering vegetation in riparian areas. In every instance, the rule (and the relevant provisions of the FPHCP) prescribes methods for conducting practices that not merely reduce the effects of those practices on the watershed processes that create and maintain riparian and/or aquatic habitat quality or quantity (or both), but also protect and enable future improvement of the extent of function existing at the time of harvest.

Therefore, in summary, the FPHCP's measures call for riparian buffers, RMAP implementation, and identification and avoidance of unstable slopes. These provisions, among others, will decrease the likelihood of sediment production, and increase the likelihood of LWD production, improve streambank integrity, minimize hydrologic alterations, and improve water quality, when added to the baseline conditions existing at the time and place a prescribed activity occurs. In turn, the proposed action does not appreciably reduce the likelihood of survival and recovery of covered species, nor does it adversely influence the conservation value of PCEs of critical habitat.

To summarize the basis for these findings, the synthesis of the effects of the proposed action considers the current status of the species and habitat, the environmental baseline, and the anticipated effects of the proposed action on watershed processes, salmonid habitat, and species life histories.

2.1.7.1 Status Summaries

2.1.7.1.1 Snake River Sockeye ESU. Only 16 naturally produced adults have returned to Redfish Lake since the Snake River sockeye ESU was listed as an endangered species in 1991. All 16 fish were taken into the Redfish Lake Captive Propagation Program, which was initiated as an emergency measure in 1991. The return of over 250 adults in 2000 was encouraging; however, subsequent returns from the captive program in 2001 and 2002 have been fewer than 30 fish.

There is a single artificial propagation program producing Snake River sockeye. Although the artificial propagation program has increased the number of anadromous adults in some years, it has yet to produce consistent returns. The majority of the ESU now resides in the captive program composed of only a few hundred fish and there are extreme risks to ESU abundance, productivity, spatial structure, and diversity.

2.1.7.1.2 Ozette Lake Sockeye ESU. The number of returning adults has increased in recent years, but is believed to be well below historical levels. Habitat degradation, siltation, and alterations in the lake level regime have resulted in the loss of numerous beach spawning sites. The reduction in the number of spawning aggregations poses risks for ESU spatial structure and diversity.

The artificial propagation program (by design) has not increased the abundance of natural spawners or natural origin beach spawners in Ozette Lake. Despite the relative increases in abundance due to the supplementation program, the total ESU abundance remains small for a single sockeye population. Although the program has a beneficial effect on ESU abundance and spatial structure, it has neutral or uncertain effects on ESU productivity and diversity.

2.1.7.1.3 Upper Willamette River Chinook ESU. The abundance of adult spring Chinook salmon (hatchery and natural fish) passing Willamette Falls has remained relatively steady over the past 50 years (ranging from approximately 20,000 to 70,000 fish), but is only a fraction of peak abundance levels observed in the 1920s (approximately 300,000 adults). Total productivity since 1995 would be below replacement in the absence of artificial propagation. Losses of local adaptation and genetic diversity through the mixing of hatchery stocks within the ESU, and the introgression of out-of-ESU hatchery fall-run Chinook, have represented threats to ESU diversity.

Collectively, artificial propagation programs in the ESU have a slight beneficial effect on ESU abundance and spatial structure, but neutral or uncertain effects on ESU productivity and diversity.

2.1.7.1.4 Lower Columbia River Chinook ESU. Many populations within the Lower Columbia River Chinook ESU have exhibited pronounced increases in abundance and productivity in recent years, possibly due to improved ocean conditions. Despite recent improvements, long-term trends in productivity are below replacement for the majority of populations in the ESU. Nearly a third of historical populations are extirpated or nearly extirpated. However, this ESU exhibits a broad spatial distribution in a variety of watersheds and habitat types.

Spring-run populations comprise most of the extirpated populations. The disproportionate loss of the spring-run life history represents a risk for ESU diversity. Hatchery programs have increased total returns and numbers of fish spawning naturally, thus reducing risks to ESU abundance. Although these hatchery programs have been successful at producing substantial numbers of fish, their effect on the productivity of the ESU in-total is uncertain. High hatchery production in the Lower Columbia River also poses genetic and ecological risks to the natural populations in the ESU, and complicates assessments of their performance. Collectively, artificial propagation programs in the ESU provide slight benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity.

2.1.7.1.5 Upper Columbia River Spring-run Chinook ESU. Despite strong returns in 2001, both recent 5-year and long term productivity trends remain below replacement. The five hatchery programs have contributed substantially to the abundance of fish spawning naturally in recent years. While spatial structure in this ESU is of little concern, it is estimated that approximately 58 percent of historical habitat has been lost. During years of critically low escapement (1996 and 1998) extreme management measures were taken in one of the three major spring Chinook producing basins by collecting all returning adults into hatchery supplementation programs. These actions, while appropriately guarding against the catastrophic loss of populations, may have compromised ESU population structure and diversity.

Overall, the hatchery programs in the ESU have increased the total abundance of fish considered to be part of the ESU. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. The overall impact of the hatchery programs on ESU spatial structure is neutral. Although the artificial propagation programs in the ESU have a slight beneficial effect on ESU abundance, they do not mitigate other key risk factors.

2.1.7.1.6 Puget Sound Chinook ESU. Populations in the ESU have not experienced the dramatic increases in abundance in the last two to three years that have been evident in many other ESUs. But more populations have increasing escapement than have decreasing escapement (13 populations versus nine). Spawner numbers however are several orders of magnitude lower than estimated historical spawner capacity, and well below peak historical abundance (approximately 690,000 spawners in the early 1900s). Recent 5-year and long-term productivity trends remain below replacement for the majority of the 22 extant populations of Puget Sound Chinook. There are moderately high risks for all VSP categories, including diversity.

The conservation and hatchery augmentation programs collectively have increased the total abundance of the ESU. The conservation programs have increased the abundance of naturally spawning Chinook, and likely have reduced abundance risks for these populations. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance and spatial structure, but neutral or uncertain effects to ESU productivity and diversity.

2.1.7.1.7 Snake River Fall-run Chinook ESU. The abundance of natural-origin spawners in the Snake River fall-run Chinook ESU for 2001 (2,652 adults) was in excess of 1,000 fish for the first time since counts began at the Lower Granite Dam in 1975. The recent 5-year mean abundance of 871 naturally produced spawners, however, is a very low abundance level for an entire ESU. Return data suggests stability in growth rate at low population levels relative to other salmonid populations, but diversity is a concern. There is a moderately high risk for all VSP categories.

The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. Collectively, artificial propagation programs in the ESU provide slight benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity.

2.1.7.1.8 Snake River Spring/Summer Chinook ESU. Recent aggregate returns (including hatchery and natural-origin fish) have increased over past numbers. However, approximately 79 percent of the 2001 return of spring-run Chinook was of hatchery origin. Short-term productivity trends were at or above replacement for the majority of natural production areas in the ESU, although long-term productivity trends remain below replacement for all natural production areas, reflecting the severe declines since the 1960s. The BRT found moderately high risk for the abundance and productivity VSP criteria, and comparatively lower risk for spatial structure and diversity.

Overall, the hatchery programs have contributed to the increases in total ESU abundance and in the number of natural spawners observed in recent years. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. Some reintroduction and outplanting of hatchery fish above barriers and into vacant habitat has occurred, providing a slight benefit to ESU spatial structure. All within-ESU hatchery stocks are derived from local natural populations and employ management practices designed to preserve genetic diversity. Collectively, artificial propagation programs in the ESU provide benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity.

2.1.7.1.9 Lower Columbia River Coho ESU. There are only two extant populations in the Lower Columbia River coho ESU with appreciable natural production, from an estimated 23 historical populations in the ESU. The recent 5-year mean of natural-origin spawners for both populations represents less than 1,500 adults. During the 1980s and 1990s natural spawners were not observed in the lower tributaries in the ESU. Short- and long-term trends in productivity are below replacement. The ESU is habitat-poor suppressing natural productivity. The BRT found extremely high risks for each of the VSP categories.

At present, the Lower Columbia River coho hatchery programs reduce risks to ESU abundance and spatial structure, provide uncertain benefits to ESU productivity, and pose risks to ESU diversity. Overall, artificial propagation mitigates the immediacy of ESU extinction risk in the short-term, but it is uncertain whether the Lower Columbia River coho isolated hatchery programs are capable of mitigating risks to ESU abundance and productivity into the foreseeable future.

2.1.7.1.10 Columbia River Chum ESU. Approximately 90 percent of the historical populations in the Columbia River chum ESU are extirpated or nearly so. Recent, extremely high natural spawner returns, are much higher than the recent past and the cause is unknown. Even so, long- and short-term productivity trends for ESU populations are at or below replacement. The BRT found high risks for each of the VSP categories, particularly for ESU spatial structure and diversity.

The Columbia River chum hatchery programs have only recently been initiated, and are beginning to provide benefits to ESU abundance. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance and spatial structure, but have neutral or uncertain effects on ESU productivity and diversity.

2.1.7.1.11 Hood Canal Summer-run Chum ESU. This ESU has also experienced increased returns with seven populations exhibiting short-term productivity trends above replacement. Of an estimated 16 historical populations in the ESU, seven populations have been extirpated or nearly extirpated. The widespread loss of estuary and lower floodplain habitat is a continuing threat to ESU spatial structure and connectivity. The BRT found high risks for each of the VSP categories.

Collectively, artificial propagation programs in the ESU presently provide a slight beneficial effect to ESU abundance, spatial structure, and diversity, but uncertain effects to ESU productivity. Despite the current benefits provided by the comprehensive hatchery conservation efforts for Hood Canal summer-run chum, the ESU remains at low overall abundance with nearly half of historical populations extirpated.

2.1.7.1.12 Upper Willamette River steelhead DPS. Recent adult returns exceeded 10,000 total fish in 2001 and 2002 for the Upper Willamette River steelhead DPS. The recent 5-year mean abundance, however, remains low for an entire DPS (5,819 adults), and individual populations remain at low abundance. Long-term trends in abundance are negative for all populations in the DPS, and the BRT found moderate risks for each of the VSP categories.

2.1.7.1.13 Lower Columbia River steelhead DPS. Some anadromous populations in the Lower Columbia River steelhead DPS, particularly summer-run steelhead populations, have increased in abundance in recent years. However, population abundance levels remain small (no population has a recent 5-year mean abundance greater than 750 spawners). No naturally viable population has been identified. The DPS exhibits a broad spatial distribution in a variety of watersheds and habitat types. The BRT found moderate risks in each of the VSP categories. Collectively, artificial propagation programs in the DPS provide a slight beneficial effect to DPS abundance, spatial structure, and diversity, but uncertain effects to DPS productivity.

2.1.7.1.14 Middle Columbia River steelhead DPS. The abundance of some natural populations in the Middle Columbia River steelhead DPS has increased over the past five years. Steelhead remain well distributed in the majority of subbasins in the Middle Columbia River DPS. The BRT found moderate risk in each of the VSP categories, with the greatest relative risk being attributed to the DPS abundance category. Collectively, artificial propagation programs in the DPS provide a slight beneficial effect to DPS abundance, but have neutral or uncertain effects on DPS productivity, spatial structure, and diversity.

2.1.7.1.15 Upper Columbia River steelhead DPS. Natural spawning Upper Columbia River steelhead have increased recently. However, these abundances well below their interim recovery target abundance levels. The predominance of hatchery-origin natural spawners (approximately 70 to 90 percent of adult returns) is a significant source of concern for DPS diversity, and generates uncertainty in evaluating trends in natural abundance and productivity. The BRT found high risk for the productivity VSP category, with comparatively lower risk for the abundance, diversity, and spatial structure categories. Collectively, artificial propagation programs in the DPS mitigate the immediacy of extinction risk for the Upper Columbia River steelhead DPS in-total in the short term, and benefit DPS abundance and spatial structure, but have neutral or uncertain effects on DPS productivity and diversity.

2.1.7.1.16 Snake River Basin steelhead DPS. The 2001 Snake River steelhead return over Lower Granite Dam was substantially higher relative to the low levels seen in the 1990s; however, the recent 5-year abundance and productivity trends were mixed. The majority of long-term population growth rate estimates for the nine available series were below replacement. The BRT found moderate risk for the abundance, productivity, and diversity VSP categories, and comparatively lower risk in the spatial structure category. Collectively, artificial propagation programs in the DPS provide a slight beneficial effect to DPS abundance and spatial structure, but have neutral or uncertain effects on DPS productivity and diversity.

2.1.7.1.17 Unlisted Steelhead.

Puget Sound DPS. Proposed for listing as a "threatened species." Recent trends in stock abundance are predominantly downward, although this may be largely due to recent climate conditions. Trends in the two largest stocks (Skagit and Snohomish Rivers) have been upward.

The majority of steelhead produced within the Puget Sound region appear to be of hatchery origin, but most hatchery fish are harvested and do not contribute to natural spawning escapement. NMFS is particularly concerned that the majority of hatchery production originates from a single stock (Chambers Creek). The status of certain stocks within the DPS is also of concern, especially the depressed status of most stocks in the Hood Canal area and the steep declines of Lake Washington winter steelhead and Deer Creek summer steelhead.

Olympic Peninsula DPS. The majority of recent trends are upward (including three of the four largest stocks), although trends in several stocks are downward. These downward trends may be largely due to recent climate conditions. There is widespread production of hatchery steelhead within this DPS, largely derived from a few parent stocks, which could increase genetic homogenization of the resource despite management efforts to minimize introgression of the hatchery gene pool into natural populations.

Southwest Washington DPS. Almost all stocks within this DPS for which data exist have been declining in the recent past, although this may be partly due to recent climate conditions. There is widespread production of hatchery steelhead within this DPS, largely from parent stocks from outside the DPS. This could substantially change the genetic composition of the resource despite management efforts to minimize introgression of the hatchery gene pool into natural populations.

2.1.7.1.18 Unlisted Sockeye.

Okanogan River ESU. Recent (1986–1995) trend estimates have been steeply downward (declining at 2 to 20 percent per year); the data appear to indicate natural environmental fluctuations. The long term trend (since 1960) for this stock has been relatively flat (-3 to +2 percent annual change). Low abundance, downward trends and wide fluctuations in abundance, land use practices, and variable ocean productivity were perceived as resulting in low to moderate or increasing risk for this ESU.

Lake Wenatchee ESU. No historical abundance estimates specific to this ESU are available. However, low abundance, downward trends and wide fluctuations in abundance, and variable ocean productivity probably mean low to moderate risk for the ESU.

Quinault Lake ESU. The 1991–1995 five-year average annual escapement for this ESU was about 32,000 adults, with a run size of about 39,000. While stock abundance has fluctuated considerably over time (recent escapements ranging from a low of 7,500 in 1970 to 69,000 in 1968), overall trend has been relatively flat. All risk factors were perceived as very low or low for this ESU.

Baker River ESU. Comparison of estimates indicates that recent average abundance is probably near the lower end of the historical abundance range for this ESU. The artificial nature of spawning habitat, the use of net-pens for juvenile rearing, and reliance on artificial upstream and downstream transportation all pose a certain degree of risk to the ESU. These human interventions in the life cycle pose some risk to the long-term evolutionary potential of the ESU.

Lake Pleasant ESU. Abundance fluctuated widely between 1987 and 1996, with a slight negative trend overall. Complete counts at a trapping station on Lake Creek in the early 1960s showed escapements of sockeye salmon ranging from 763 to 1,485 fish, and 65,000 sockeye salmon smolts were reported to have outmigrated in 1958 (Crutchfield et al., 1965).

2.1.7.1.19 Unlisted Pink Salmon.

Even-Year Pink Salmon ESU. At the present time, the Snohomish River even-year pink salmon population is relatively small, on the order of a few thousand adults per generation. The small size of the current Snohomish River even-year pink salmon population suggests that it may be part of a larger geographic unit on evolutionary time scales (hundreds or thousands of years).

Odd-Year Pink Salmon ESU. Of the 15 odd-year pink salmon stocks identified in Washington, nine were classified as healthy, two as critical (lower Dungeness and Elwha Rivers), two as depressed (upper Dungeness and Dosewallips Rivers), and two as unknown (North and Middle Fork Nooksack, and South Fork Nooksack River). The two most distinctive Puget Sound populations, the Nooksack and Nisqually River populations, show non-significant trends in recent abundance.

2.1.7.1.20 Other Unlisted Species.

White sturgeon. Although the lower Columbia River population probably declined during the 1980's, adoption of more restrictive harvest regulations appears to have stabilized the population (Tracy 1993). Impoundments and altered hydrographs caused by development of the hydropower system have altered critical spawning habitat (Parsley et al., 1993). Because the factors identified as causing declines in other white sturgeon populations are present to varying degrees in each of the other eight upstream impoundments, these populations are likely declining as well.

North American green sturgeon. In its 2005 review, NMFS' BRT concluded that the Northern Green Sturgeon DPS was not in danger of extinction now or likely to become endangered in the foreseeable future throughout all of its range.

Eulachon Smelt. Run sizes, as indexed by commercial landings, remained relatively stable for several decades, with the exception of 1984, until landings dropped suddenly in 1993 and remained low for several years thereafter. The eruption of Mt. St. Helens severely impacted spawning in the Cowlitz River in 1980 and subsequent returns in 1984. Smelt returns in 1984 could also have been impacted by the record large El Nino event of 1982-1983. Commercial landings from 1938-1989 averaged 2.1 million pounds per year. Landings in 1994 were only 43,000 pounds and beginning in 1995, fishery restrictions were enacted. Due to reduced seasons during 1995-2000 landings are not completely comparable with previous years; however, it is apparent that the abundance of smelt in the Columbia River Basin was much reduced during 1993-2000.

Although total commercial landings remained low in 2000, other abundance indices suggested a significant improvement in the smelt return for 2000. The 2001 return continued the trend of increasing abundances that began in 2000 and is the first year since 1988 in which smelt returned to the Sandy River. The 2001 return, as indexed by commercial landings and CPUE data, was the largest return since 1993. Total landings in 2002 were the largest since 1992 and CPUE in the Columbia River commercial fishery was the third highest on record (since1988). The commercial landings in 2004 are the lowest since 2000, and about a tenth of the 2003 landings, despite a liberal season and favorable market. Likewise, the 2004 observed CPUE is the lowest since 2000, and less than half the 2003 observed CPUE.

Ubiquitous Unlisted Species. Shiner perch (*Cymatogaster aggregata*), Pacific staghorn sculpin (*Leptocottus armatus*), starry flounder (*Platichthys stellatus*), surf smelt (*Hypomesus pretiosus*,) Pacific sandlance (*Ammodytes hexapterus*), longfin smelt (*Spirinchus thaleichthys*) and Pacific herring (*Clupea pallasii*) have no status under the ESA. Each is considered ubiquitous, and no other status data presently exists.

2.1.7.2 Baseline Summary

The description of the environmental baseline assessment is organized by groups of the state's WRIAs. This organization provides a format for assessing environmental conditions relevant to the proposed action that enables effects analysis at a programmatic scale. According to the environmental baseline assessment, a general condition in each WRIA is habitat modification from past land and other management activities such as the existence of dams, operating water diversions, and land use change affecting many places in the action area. Relative to those factors affecting habitat in the action area, the contribution of past timber harvest and related management appears to be a relatively small but contributing factor affecting salmonids in the action area. Habitat conditions include chronic sediment from a variety of sources, places with altered temperature regimes, and decreased instream woody debris.

Conditions in areas managed under the Forest Practices Act are likely improving as the result of functional enhancements occuring since the FFR practices began implementation as emergency rules in 1999. Nevertheless, riparian stands harvested under older regulations within the past few decades are typically dominated by hardwoods or conifers too small to provide functional woody debris to adjacent watercourses. Timber harvest and road building on unstable slopes increased mass wasting and caused a widespread simplification of aquatic habitat. Forest roads provided raw material and pathways for chronic sediment inputs and turbidity. In some locations, pool frequency was reduced, pool depth was diminished and overall complexity of habitat units was decreased. Furthermore, the removal of riparian shade caused an increase in stream temperatures. As these places become reforested and mature since previous harvest, they begin provide improved habitat function, enabling development of the processes that create and maintain condition meeting the ecological needs of covered species. This will be especially true of stands that approach mid-seral stand age and condition.

Habitat degradation from all sources in the action area has adversely affected salmonid population viability. The existing data suggest long-term declines continuing up to the present, with recent increased abundance thought to be from improved ocean conditions. The changes in habitat described above have, over the longer term, reduced juvenile survival rates through decreased fry emergence rates, lack of summer and winter rearing habitat and, in some cases, loss of suitable estuarine habitat. In places where stands become reestablished as they approach harvest under the FPHCP, degraded conditions should naturally abate.

The historic practices and actions that created existing environmental baseline conditions have created a legacy of present habitat function issues. In each WRIA in the action area, there are riparian stands not providing adequate supplies of large woody debris. Chronic sedimentation inputs and landslide rates from both roads and harvested hillsides continue to impair stream habitat. Habitat conditions include decreased pool frequency and quality; substrate conditions and overall channel complexity are decreased. Similarly, roads and harvested riparian areas have cased vegetation and water quality issues. Seven years of improved practices under the 1999 emergency rules and subsequent permanent rules changes have probably begun to address these forest-practices related habitat issues. Looking at how these conditions will change as previously harvested stands approach next harvest under the FPHCP, places with decreased rearing habitat and degraded spawning conditions should begin to present increased function and improved processes merely through the natural maturation of those stands as they reach mid-seral conditions typical of commercially harvested forest land.

2.1.7.3 Effects Summary

The Biological Opinion presents the direct and indirect effects of the proposed action (issuing an ITP and covering unlisted species in the HCP and IA for the salmonids and other listed fish listed in Table 1). The effects of the proposed action are those stemming from conducting forest practices and management activities according to the provisions of the FPHCP. The FPHCP generally consists of an assemblage of Washington State Forest Practices Rules and other programs that took effect in January 2000. Those regulations (and the accompanying programs that are part of the FPHCP) were devised in part, to improve upon forest practices activities under past and historic regulatory scenarios and address the resulting modified watersheds, and decreased riparian and aquatic habitat function, affecting many species of salmonids and other fish.

The analysis is organized around how covered forest practices influence five indicators of watershed health: 1) water (hydrology and temperature), 2) woody debris, 3) chronic sediment (surface erosion), 4) catastrophic sediment (mass wasting), and 5) nutrients. Since these factors control the quality and distribution of aquatic habitat, the analysis assumes that fish populations respond to changes in the inputs of these watershed products because declines in the quality and distribution of aquatic habitat from changes in these products appear to be a factor in the current status of fishes in the action area. Several mechanisms of habitat modification that may occur as a result of the proposed action are identified. These habitat modifications are considered, below, in terms of fish spawning and emergence, and juvenile rearing and migration.

2.1.7.3.1 Management-related Peak Flow Increases. While the hydrologic regime is likely different than what historically occurred prior to any management in these watersheds, the effects of the proposed operations under the FPHCP are small and not limiting to populations of fishes in the action area. When added to baseline conditions, the proposed roads program will result in slightly greater rates of recovery of hydrologic processes, given the greater emphasis on improving fish passage and passage of floods and wood through water-crossing structures; and on the repair of existing road faults and improvement in design of new roads. Localized impacts (for example, enlargement of receiving channels and increased sediment delivery) associated with peak flows can occur. However, channel expansion due to peak flows may have largely occurred during previous timber harvest and any additional channel widening will likely not be as extensive as that following the first harvests. Future effects will likely be much smaller than those that occurred during the first harvests. The distribution of stand ages across the action area greatly diminishes the likelihood of concentrated timber harvest over larger areas and, therefore further reduces the likelihood and extent of modified peak flows, and the likelihood of adverse effects in larger fish-bearing channels and nearshore areas. The FPHCP's riparian timber harvest prescriptions and required RMAPs meet the ecological needs of listed species.

2.1.7.3.2 Large Woody Debris Recruitment and Function. In-stream LWD will remain low in the near term as the result of practices under past regulatory regimes (factors affecting the environmental baseline), especially in larger streams, as LWD recruitment sources are less robust under those regimes. Hardwood conversion activities will remove less desirable hardwood sources of LWD (but enable conifer sources to flourish, with improvements beginning to accrue in about 40 years). Furthermore, the LWD supplied by forests logged under those previous regulations will continue to naturally decay and move through affected watersheds under natural fluvial transport. As previously affected watersheds approach their next commercial rotation, the provisions of the FPHCP will apply, resulting in more sources of LWD than in the past and improved functions sufficient to meet the ecological needs of listed species, when recruited wood is added to the environmental baseline.

Existing roads authorized under past practices in the environmental baseline would continue to affect LWD recruitment, particularly where roads run parallel to streams. Under the FPHCP, rules for new roads and RMAPs will lead to the retention (and growth) of more trees in the RMZ along fish-bearing streams. This, in turn, will lead to mature forest stand characteristics and improved LWD functions throughout the action area. These improvements will eventually be sufficient to meet ecological needs.

Some LWD in fish-bearing streams and nearshore areas is washed down from non-fish-bearing streams, and timber harvest allowed under the riparian prescriptions on Type Np and Type Ns streams will limit the contribution of LWD supply from these sources to downstream fish-bearing streams. On portions of Type Np streams, RMZs will be at least 50 feet wide, which is less than the one site potential tree height buffer width recommended for 100 per cent function in most literature. Because of the relatively narrow RMZs, there will be a greater potential for windthrow and a loss of wood that would have been recruitable if allowed to mature. Also, harvest will be allowed to the streambank on Type Ns and all other Type Np streams. Therefore, although site conditions may result in leaving riparian trees, there will be no assurance of direct protection of LWD recruitment potential from these sources. However, many Type Np and Ns stream segments flow within steep, confined channels that would have adjacent steep banks protected as unstable slopes, limiting their value as recruitment sources in the first place. Thus, despite not gaining a source of recruitable wood from non-fish-bearing stream RMZs, sufficient LWD will be available because the FPHCP prescribes protection of the unstable landforms that are the primary sources of LWD.

2.1.7.3.3 Chronic and Mass Wasting-derived Sediment. The FPHCP provisions covering riparian harvest and management, including tree retention in protective buffers, were substantially improved, compared to the forestry regulations in effect prior to January 2000. As a result, the function of riparian buffers and consequent effects on stream and nearshore habitat and covered fishes will improve. Habitat functional condition will be better after future forest practices under the proposed FPHCP, when compared to the historical forest practices that contributed to environmental baseline conditions. Therefore, conditions will improve when the effects of the proposed action are added to the environmental baseline and will be sufficient to meet the ecological needs of listed species.

The RMZ widths for Type S and Type F streams are wide enough to trap most suspended sediment transported as overland sheet flow. Timber harvest within the Inner Zone will not add to instability because of the limited number of trees that can be cut under riparian stand target requirements. Timber harvest in the Outer Zone or outside the required buffer may be linked to accelerated slope failure that delivers to aquatic resources, but vulnerable areas would be identified and protected. Failure to identify such areas before practices occur would be rare.

Movement of heavy equipment within the riparian zones will be very limited and will not generally occur within the Core Zone. Best Management Practices will be used to minimize soil disturbance. Harvest restrictions on unstable slopes and sensitive sites will result in reduced likelihood and extent of sediment delivery to streams and nearshore areas, minimizing impacts to biological processes such as aquatic insect production or the survival to emergence of eggs and alevins.

Under the 20-acre exemption provisions governing practices on fish-bearing streams, shade provisions will retain many trees and minimize ground disturbance. However, due to the combination of reduced buffer width and harvest restrictions, riparian areas will not always receive the same sediment filtration protection as they would under the provisions of the FPHCP. The difference in the extent of function between these and other parcels operated under the standard FPHCP riparian prescriptions is substantially limited in degree and extent by conditions in the proposed ITP.

Type Np and Type Ns waters, which are not occupied by NMFS-listed species, receive some protection from sediment delivery from 30-foot equipment limitation zones, but places with a high density of Type N channels could see compounded sediment effects. Therefore, unbuffered Type N watercourses in harvest units could receive short-term (within the first 18 months after harvest) delivery of fine sediment. The majority of sediment transported from harvest units adjacent to unbuffered type N watercourses will occur during the first year or two following harvest or site preparation, decreasing as the harvest sites are revegetated.

Although roads will continue to deliver some sediment to streams and nearshore areas, forest practices road rules under the FPHCP will reduce fine sediment generated from the road network. The measures proposed in the FPHCP may provide for more rapid improvements (than would occur in the absence of the FPHCP) given the emphasis on (a) identifying unstable slopes and requiring greater environmental review for new roads planned for potentially unstable slopes; (b) inventorying roads; (c) scheduling and upgrading roads to new standards prior to 2016; and (d) testing basic assumptions related to road rules through the adaptive management program.

As a result of these prescriptions, we do not anticipate adverse effects to downstream habitat (in the form of pool filling and substrate degradation) and covered fish species (directly by turbidity-related effects on feeding and rearing) from the delivery of fine sediments from harvest, forest roads, and site preparation-related activities. Thus, under the FPHCP, stream systems will experience variability in habitat conditions sufficient to meet the ecological needs of listed species.

2.1.7.3.4 Nutrients. Nutrient levels provided from streamside and nearshore vegetation under the FPHCP will increase over time from levels that probably already meet the ecological needs of covered species. During hardwood conversion, possible reductions in alder detrital inputs may be ameliorated by the untreated CMZ and the 50-foot no-harvest Core Zone adjacent to Type S and F streams and portions of Type Np streams. However, based on recent experience, few potential sites will be converted. Nutrient inputs will likely be maintained, given the prevalence of red alder across the action area, and the inherent patterns of riparian disturbance. Nutrient levels may also increase as fish passage is enhanced, spawning areas become accessible again, and spawned-out salmon carcasses contribute marine-derived nutrients to upstream aquatic and riparian areas.

2.1.7.3.5 *Water Temperature.* Overall, the likelihood of adverse temperature effects are considered low for all fish-bearing streams and nearshore areas. Temperature conditions, and therefore protection of fish resources, are expected to improve relative to baseline conditions.

2.1.7.3.6 Habitat Access. Removing fish-passage blockages will restore spatial and temporal connectivity of streams within and between watersheds where fish movement is currently obstructed. This, in turn, will permit fish access to areas critical for fulfilling their life history requirements, especially foraging, spawning, and rearing. Since 2001, approximately 705 miles of previously blocked streams have been opened to fish passage and over 1,200 structures have been removed or replaced under the RMAP process (WFPA 2005 as cited by Vogel).

However, the removal of fish passage barriers could have short-term, temporary adverse effects to fish. In-stream use of heavy equipment could smother or crush eggs and alevins, increase turbidity and deposition, block migration, and disrupt or disturb overwintering behavior.

With the assessment and replacement schedules established under the RMAPs, the need for in-stream work, dewatering, and fish capture/handling will diminish over time, until most, if not all, blockages are eliminated by the end of 2016. Adverse effects from fish passage barrier removal will be further minimized by following NMFS and WDFW protocols. The short-term (less than one week) impacts will be offset by the immediate and long-term benefits provided from providing upstream fish passage.

2.1.7.3.7 Worksite Isolation and Fish Locating and Handling. Culvert replacements and in-channel work are not frequent, but they have overall positive benefits. However, removing fish from work areas has the potential to harm and kill fish, even under Service-approved protocols. Dewatering of the work area and removing the fish are common practices used to minimize these impacts. Seines and dip nets will be used as the first method of capture to remove any fish which may be trapped when a stream is dewatered for instream work. The use of seines and dip nets are expected to capture approximately 75 percent of the fish within the section of stream to be dewatered. In most cases, fish will not be injured using this method, although it may disrupt foraging temporarily. In most cases, salmonids are unlikely to be present as projects would be timed and located of to avoid exposure of the most vulnerable life histories. However, salmon and steelhead may in some cases be present as the allowable work windows primarily only limit the work to when listed fish are least likely to be present.

Electrofishing has the potential to harm and kill fish even under Service-approved protocols. In most, if not all circumstances, electrofishing would be attempted only after less harmful methods of fish removal have been used. The actual impact of the capture and handling of salmonids using electrofishing is short-term in nature, occurring intermittently over one to several days. However, it may result in permanent, adverse impacts (i.e., death and injury). Not all flow diversions are likely to result in electrofishing impacts as it may be used only when listed species are least likely to be present in the affected area.

2.1.7.3.8 Relating Environmental Effects to Habitat and Life History. In general, the proposed action will provide for the development of higher functioning in-stream, nearshore, and riparian zone conditions (i.e., suitable substrates, sufficient shade, bank stability, litter inputs, and a continual source of LWD) when effects of the proposed action area added to the environmental baseline. The proposed action will promote a shift in the distribution of habitat conditions towards one of increasing complexity. This will occur principally due to a decrease in the average long-term delivery rate of sediment from roads and timber harvest activities, and from a substantial improvement in riparian buffer requirements. Although the action area is recovering from a long legacy of intensive timber harvest that predates current forest practice rules, the implementation of the proposed FPHCP will promote improvements in habitat conditions from baseline conditions. These improvements will eventually meet the ecological needs of listed species. This continued recovery is vital to fishes in the action area where some populations are severely depressed.

However, the rate of these improvements is likely very different from the rate at which the degraded conditions were created. In essence, there is likely a lag time for attaining certain habitat functions when sediment supply is decreased because of the gradual transport of stored sediment out of the channel. Likewise, a delay in attaining adequate shade and functional LWD inputs is expected, as trees grow to sizes large enough to provide these functions, especially adjacent to larger streams. The temporary lack of wood, depending on the current age of trees in the riparian buffer, may cause a lack of the structural elements that: (a) store sediment, (b) moderate sediment impacts by gradually releasing it to downstream reaches, and (c) form pools. These effects, however, are not caused by the proposed action. Rather, they are a result of the generally degraded habitat conditions caused by historical forestry practices. Given the distribution of past impacts across the action area and consequent channel impacts, there is likely a range of recovery rates for overcoming these conditions.

In summary, the FPHCP will meet the biological requirements of listed species. Implementation of the Forest Practices Rules will reduce overall sediment inputs (although they may remain above natural levels) and increase functional LWD and canopy cover. Nutrient inputs should be unchanged, or even improved, and temperature conditions will improve from baseline conditions. The FPHCP will cause a net improvement in habitat quality when compared to baseline conditions. Improvements to reproductive success, juvenile fish rearing, and feeding habitat will be observed as improvements occur in water temperature, pool quality and quantity, and channel diversity and stability.

Changes in the flux of watershed products and changes in habitat were summarized above. These changes in terms of life-history stage effects are discussed below. In general, implementation of the FPHCP will result in improvements to spawning and rearing habitat. As the recruitment of woody debris improves over the several decades, the expected channel response will be one of gradual channel recovery, with a range of life history responses.

Spawning and Egg Incubation. The proposed FPHCP will result in reductions in the amount of fine material delivered to channels when compared to baseline conditions, mainly from the implementation of RMAPS, increased riparian buffer widths, and identification/avoidance of unstable slopes. As previously discussed, the channel response will be sufficient to reduce the impacts associated with fine sediments. Improved water temperature conditions due to increased canopy cover will minimize the accelerated development of eggs. Increased canopy cover is also expected to improve shoreline-shading in the estuarine and marine habitats, thereby improving conditions for incubating surf smelt and sand lance eggs. Overall, the implementation of the proposed action will produce improved spawning habitat. This will increase the success of egg incubation as oxygen-supplying stream flow through redds is increased and substrates resist shifting during peak flows. Reductions in delivery of fine sediments to estuarine and marine waters, when compared to baseline conditions, are also expected to minimize the potential effect to the intertidal spawning habitat of surf smelt and sand lance.

Emergence. The proposed FPHCP will result in reductions in the amount of fine material delivered to channels when compared to baseline conditions, due principally to increased riparian buffer widths, RMAPs (e.g., hydrologically disconnected roads), and identification/avoidance of unstable slopes. As previously discussed, the channel response will be sufficient to avoid the impacts associated with fine sediments. Furthermore, improved temperature conditions due to increased canopy cover will minimize the accelerated emergence of fry. Overall, the implementation of the proposed action will cause a reduction of embedded streambed conditions throughout much of the action area, and thus an improvement in the emergence success of salmonids.

Juvenile Rearing. Rearing habitat is located in the larger tributaries where the effects of sediment delivery and wood recruitment accumulate. Much of this habitat, particularly for species such as coho salmon which utilize pools for much of their rearing, occurs in lower gradient alluvial reaches, where the sensitivity to wood and sediment inputs is greatest. Past activities in the action area have caused simplified habitat conditions in these reaches, limiting the production of juveniles. Given the reduction of sediment inputs from management-related mass wasting and harvest- and road-related runoff, rearing habitat conditions, such as food production, will improve with implementation of the FPHCP. Furthermore, improved temperature conditions due to increased canopy cover will decrease the susceptibility of juvenile salmonids to certain parasites and diseases, and minimize alterations to competitive interactions between species. Overall, the quantity and quality of pools used for rearing will improve during summer months (recovery of adequate pool depths for shelter) and winter months (recovery of adequate roughness features for high flow refuge). Therefore, there will be a general tendency toward channel improvements and an increase in juvenile survival and rearing capacity. Similarly, the forest practices rules are expected to result in improved rearing conditions for estuarine and marine species, relative to baseline conditions, through reductions in the delivery of fine sediments and through increased inputs of LWD.

Salmonid Smolt Migration and Survival. The effects on growth and migration are difficult to determine. However, the proposed action will minimize the delivery of excessive sediment, increase the quantity and size of LWD, and improve water quality (e.g., temperature). Under these conditions, juvenile growth rates may increase due a reduction of inter- and intra-specific competition in the limited habitat. Furthermore, the roads measures will lead to reductions in turbidity levels, which will likely improve the growing conditions of juvenile salmonids.

Adult Rearing. Adult rearing conditions are expected to improve for estuarine and marine species, relative to baseline conditions, through reductions in the delivery of fine sediments and through increased inputs of LWD.

2.1.7.3.9 Relating Habitat Effects to Fish Populations. When added to the environmental baseline, the proposed action will allow for overall gradual improvements in habitat conditions from baseline conditions. Fundamentally, improvements accrue from the harvest of individual forestry units under the FPHCP prescriptions, when they have reached a commercial condition typical of mid-seral forests (between 30 and 70 years old, or 50 years on average for western Washington). Improved conditions will result in the form of improved channel morphology, LWD recruitment sources, streambank integrity, shading, water temperature, and reduced sediment inputs to levels meeting the ecological needs of fish with life histories in harvested areas (or with life histories that are influenced by conditions the harvested areas). A range of species responses to these habitat improvements will occur, depending on the current status of the species and the location of forestry activities. For example, reduced occurrences of sediment pulses would decreased the extent, if not the likelihood, of localized reductions in short term reproductive success. Furthermore, long-term improvements in the condition of other habitat functions will occur as riparian buffers mature, leading to increased shade and sources of LWD will positively influence measures of salmonid population viability.

All of these improvements result from a shift forest practices and management that was first implemented in 2000 and, taken with other programmatic actions, are captured in the proposed FPHCP. That shift generally prescribes practices affecting watershed processes at the local scale. Some of those effects can modify habitat to an extent that injures or kills fish by impairing their normal behavioral patterns. However, habitat modification will be greatly reduced, or minimized in a manner that enables continuation of the natural functional processes that restore and maintain habitat. This result is obvious especially in comparison to the past practices that created the condition of the environmental baseline. Importantly, this comparison is not the basis of NMFS' eventual determinations regarding species' jeopardy or critical habitat adverse modification. However, illustrating the relationship of changes to the forest practices resulting from future operations under the FPHCP is informative of the bases for those changes, and how they influence the population viability of covered species.

Past forest practices regimes have informed the condition of the baseline both at the time of this consultation. As forestry units mature to a mid-seral condition typical of timber harvested for commercial purposes, they develop from the conditions left after they were previously harvested. In some places, those conditions degraded habitat function to the extent that population productivity was adversely affected. In contrast, the FPHCP was developed with prescriptions that are sufficiently protective of existing function at the time of forest practices. More importantly, the prescriptions result in post-practice conditions that better meet the ecological needs of covered species in terms of the functions that create and maintain riparian and aquatic habitat. Therefore, although practices affect individual fish at the operational unit scale of analysis, as forest units come on-line for harvest and as more of the action area is treated under RMAPs, more of the action area will be in a condition improving habitat functional condition.

Furthermore, NMFS has screened each of the covered species for individual populations of those species for instances of populations that would be reasonably certain to more acutely experience the effects of the proposed action. NMFS looked closely at those species that were either population limited (species made up of very few distinct populations), range limited, or both to determine if the effects of the action could lead to instances where acute short term effects that were severe enough on local populations as to effect populations viability.

Under this scenario NMFS could not identify any instance where the effects of practices under the FPHCP rise to a level that could be interpreted as adversely influencing any of the attributes of viable salmonid populations (McElhany et al., 2000). As such, the anticipated effects of the proposed action on individual covered fish will not increase the risk of extinction of the covered species and therefore not appreciably reduce the likelihood of both the survival and recovery of covered species. That conclusion is true for all of the covered species including those identified during consultation as requiring specific attention due to the vulnerability of certain populations within those species.

2.1.7.4 Summary of Effects on Designated Critical Habitat

Critical habitat is designated for all but one of the listed ESUs and DPSs (i.e., the Lower Columbia River coho ESU) addressed in the HCP and Opinion. Critical Habitat is not designated for any of the other covered species, since they are not listed. The proposed permit would cover a great extent of non-Federal forest in Washington State. These lands contain critical habitat that was first designated in 1993 or for which designation became effective on January 2, 2006. These designations invoke slightly different terminology to describe the essential features or constituent elements of critical habitat, although there is substantial similarity between the “essential features” from the 1993 designation and the “primary constituent elements” from the 2006 designation. This Opinion refers all of these as “PCEs” and the analysis evaluates whether the issuance of the proposed permit will influence the conservation value of critical habitat in terms of the PCEs of critical habitat.

This biological opinion does not rely on the regulatory definition of “destruction or adverse modification” of critical habitat at 50 CFR 402.02. Instead, this section relies on the statutory provisions of the ESA to complete the analysis. Therefore, regardless of the difference in terminology between the two sets of designations (1993 and 2006), the analysis determines whether the effects of the action on PCEs at the local level have any influence on the conservation value of the designated critical habitat. If the conservation value of the overall designation is adversely affected, then NMFS would determine that the action probably adversely modifies or destroys critical habitat. If the proposed action would adversely modify or destroy critical habitat, then NMFS must provide a reasonable and prudent alternative, which would, among other things, avoid such destruction or adverse modification.

2.1.7.4.1 The Primary Constituent Elements of Critical Habitat. The four components of essential Snake River salmon habitat within designated critical habitat are: 1) spawning and juvenile rearing areas; 2) juvenile migration corridors; 3) areas for growth and development to adulthood; and 4) adult migration corridors (December 28, 1993, 58 CFR 68544).

The essential features of juvenile spawning and rearing areas, as well as juvenile migration corridors are 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. The essential features of adult migration are the same, excluding food.

The essential features of sockeye nursery areas are adequate (1) spawning gravel, (2) water quality, (3) water quantity, (4) water temperature, (5) food, (6) riparian vegetation, and (7) access. These essential features differ somewhat from those of other salmonids because of differing life history expression.

The PCEs for Puget Sound Chinook, Lower Columbia River Chinook, Upper Willamette River Chinook, Upper Columbia River spring-run Chinook, Hood Canal summer-run chum, Columbia River chum, Ozette Lake sockeye, Upper Columbia River steelhead, Snake River Basin steelhead, Middle Columbia River steelhead, Lower Columbia River steelhead, and Upper Willamette River steelhead were effective on January 2, 2006 (September 2, 2005, 70 FR

52630). They include: (1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development. (2) Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage supporting juvenile development; and (iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. (3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. (4) Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. (5) Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. (6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

The proposed FPHCP prescribes measures for limiting timber harvest activities (harvesting, bucking, felling, and yarding) in the riparian zone and road maintenance and abandonment throughout the action area, and requires identification and protection of unstable slopes and other sensitive sites. The environmental baseline for these places is variable throughout the action area, based mainly on when the most recent management occurred, the regulatory regime governing State forest practices at the time that management occurred, and any site-specific provisions applied when management occurred. Places having undergone forest management operations under past regulatory regimes that were less protective of salmonid habitat functional conditions, are likely to have less functional present habitat conditions, unless those past practices are remote enough for function to have passively returned.

2.1.7.4.2 Summary of the Effect of Forestry Activities on PCEs. Timber harvest that reduces vegetation in riparian areas can affect shade (and thus, water temperature), the extent of large wood available for recruitment to streams (affecting structural components of instream habitat), detrital inputs (affecting salmonid food sources), and sediment capture (affecting water quality while suspended and substrate when deposited). Road construction and maintenance can enable erosional processes that also deliver sediment to streams. All of these effects can influence the ability of affected areas to support spawning, incubation, larval development, juvenile growth and mobility, and adult mobility.

While timber harvest practices and activities related to forest roads would continue under the FPHCP with the effects described above, the FPHCP would alter the location and intensity of forest practices in a manner intended to support the functional processes that create and maintain riparian and aquatic habitat for covered species, with ramifications for designated critical habitat. The history of forest practices in Washington State leaves an environmental baseline condition in which many riparian areas consist of post-harvest regrowth, with stands of trees that are predominantly early to mid-seral in maturity. Many riparian areas affected by past harvest have only a very narrow band of intact vegetation next to the streams. The FPHCP prescribes the retention of trees in suitable buffers to provide adequate shade, sediment capture, stream bank stability, detrital inputs, and sources of LWD that support the biological requirements of the covered species. Operation under these prescriptions would protect riparian conditions existing at the time of harvest and enable development of more robust function as retained riparian vegetation matures after harvest and adjacent harvest units regenerate. These improvements would increase forage and cover, and decrease water temperatures, all of which improve PCEs, particularly for survival, growth, and maturation, of juvenile salmonids.

The types of effects described above (reduced riparian vegetation, spikes in sediment and turbidity) also occur under natural conditions, forcing stream velocity changes, thalweg realignment, and aggradation or degradation of stream beds, among other things. When these changes are part of a natural rate of change and not triggered by anthropogenic causes, they are considered part of the habitat forming processes that salmonids are adapted to, and need to thrive. Thus, a factor to consider in evaluating the degree or significance of these changes is to determine if the rate of change caused by management according to the FPHCP prescriptions is accelerated beyond that which salmonids can respond to successfully. In this case, the change are minimized by the prescription of practices, the results of which protect functional processes that make and maintain the habitat of convered species, exsting at the time and place those practices occur. Furthermore, the prescriptions enable further development of functional after those practices such that any changes in the critical habitat of the ESUs and DPSs are at a frequency for any given watershed that they are not expected to increase the rate of systemic habitat change outside of the normal rate of variation, and thus they should not diminish the ability of salmonids to respond to the changes in their environments. Accordingly, the habitat effects of the FPHCP should not impair the conservation value of the habitat at the operational unit scale. Since the commercial stand age inventory is dispersed throughout the State, concentrated operations affecting PCEs beyond the local scale are unlikely. Thus it follows that the proposed action is unlikely to affect conservation value of watersheds in which affected PCEs are located. Therefore, whether or not such operations occur in watersheds categorized as having low, moderate, or high conservation value by NMFS CHART teams, the proposed action is not likely to influence the conservation value of any designated critical habitat.

2.1.8 Conclusion

After reviewing the best available scientific and commercial information regarding the biological requirements and the status of the ESUs/DPSs considered in this consultation, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of these species, and is not likely to destroy or adversely modify critical habitat.

2.1.9 Reinitiation of Consultation

Reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) If the amount or extent of taking specified in the incidental take statement is exceeded; (b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) If the identified action is subsequently modified in a manner that has an effect to the listed species or critical habitat that was not considered in the biological opinion; or (d) If a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR 402.16). To reinitiate consultation, contact the Washington State Office Habitat Office of NMFS and refer to the NMFS Number assigned to this consultation.

2.2 Incidental Take Statement

Section 9(a) (1) of the ESA prohibits the taking of endangered species without a specific permit or exemption. Protective regulations adopted pursuant to section 4(d) extend the prohibition to threatened species. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 CFR 222.102). Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(o) (2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

The proposed action, issuing an ITP, does not cause incidental take; it authorizes the incidental take occurring during other activities conducted according to the provisions of the FPHCP. The ITP itself does not permit the underlying activities that cause incidental take so much as provide an authorization that lifts the prohibition against take in ESA section 9 (and extended to threatened species through ESA section 4(d)).

The incidental take that is the subject of the proposed permit and addressed in the FPHCP occurs mostly in the form of harm, where habitat modification, despite minimization and mitigation in the FPHCP, will impair normal behavior patterns of listed salmonids to an extent that actually injures or kills them. The activities that cause the habitat modification and the extent of anticipated habitat modification are 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. In parts, if not all of 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 Forest Practices Rules, 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 is further complicated, if not rendered impossible, when the scale of the proposed action is considered. 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. An ITP covering activities on 9.3 millions acres of land in Washington State might occur any time in the 50 years following ITP issuance. Finally, estimating the amount of take requires distinguishing between habitat modifications that would occur if the ITP were issued and the FPHCP was implemented, versus habitat modifications that would occur if they weren't.

2.2.1 Amount or Extent of Anticipated Take

Take will occur in the form of wounding or killing from worksite exclusion activities, and "harm" from habitat modified during forestry and road maintenance and construction activities. Take is primarily anticipated in the form of harm. 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 that will occur as prescribed in the FPHCP. Reinitiation of formal consultation is triggered when habitat modifications exceed those evaluated in this Opinion.

Harm. Take in the form of harm will result from reduced function of watershed processes that create and maintain habitat meeting the ecological needs of the covered species. Harm will accrue from the environmental effects of timber harvest and road construction and maintenance activities in the areas of Washington State described as the action area for the foregoing Biological Opinion. Specifically, habitat modifications that may cause take will occur in the form of: (1) sediment inputs into water; (2) reduction in riparian vegetation; (3) reduction in the sources of large woody debris recruitment; and (4) warm water temperatures.

The following table describes the circumstances in which take in the form of harm is likely to occur – those circumstances are harvest in riparian areas on type N streams, at stream crossings in type S, F, and Np streams, and at roads adjacent to type S, F, and Np streams. The mechanisms in which harm accrues at these sites is articulated in the effects analysis provided earlier in the document and summarized after Table 6, below, with a specific focus on lifestages likely to be affected. Each of these four mechanisms of harm is expected in each WRIA where the HCP is in effect, but not all ESUs are present in each WRIA. Therefore, the last column of the table indicates which ESUs are present in each WRIA, and are therefore likely to be taken from those activities within the WRIA.

Table 6 Extent of Habitat Affected, by WRIA

WRIA Number	WRIA Name	Total riparian acres adjacent to Type N streams (acres subject to harvest)	FPHCP stream crossings on Type S, F, and NP streams (locations subject to in-water work)	FPHCP stream-adjacent rd mi. on Type S, F, and NP streams (locations subject to sediment contribution & riparian vegetation loss)	Species/ESU Presence	Species/ESUs Likely to Experience Take
1	Nooksack	21,278	894.0	152.4	Puget Sound/ Strait of Georgia Coho; Baker River Sockeye, Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink: Puget Sound /Strait of Georgia Chum	Puget Sound/ Strait of Georgia Coho; Baker River Sockeye, Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink: Puget Sound /Strait of Georgia Chum
2	San Juan	1,931	105.0	16.8	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum
3	Lower Skagit/Samish	13,222	640	122.1	Puget Sound/Strait of Georgia: Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Straight of Georgia Chum	Puget Sound/Strait of Georgia: Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Straight of Georgia Chum
4	Upper Skagit	11,774	574	90.8	Puget Sound/Strait of Georgia Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum	Puget Sound/Strait of Georgia Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum

5	Stillaguamish	14,697	622	102.7	Puget Sound/Strait of Georgia: Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Straight of Georgia Chum	Puget Sound/Strait of Georgia: Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Straight of Georgia Chum
6	Island	1,485	103	12.9	Puget Sound/Strait of Georgia: Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Straight of Georgia Chum	Puget Sound/Strait of Georgia: Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Straight of Georgia Chum
7	Snohomish	35,173	1650	295.1	Puget Sound/Strait of Georgia: Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Even Year Pink Salmon; Puget Sound/Strait of Georgia Chum	Puget Sound/Strait of Georgia: Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Even Year Pink Salmon; Puget Sound/Strait of Georgia Chum
8	Cedar-Sammamish	7,733	305	84.8	Puget Sound/Strait of Georgia: Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Straight of Georgia Chum	Puget Sound/Strait of Georgia: Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Straight of Georgia Chum
9	Duwamish-Green	8,211	279	66.6	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum
10	Puyallup-White	22,780	902	160.6	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum
11	Nisqually	16,868	712	136.8	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum

12	Chambers-Clover	802	26	10.9	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum
13	Deschutes	6,800	288	59.8	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum
14	Kennedy-Goldsborough	5,598	316	49.4	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum
15	Kitsap	16,822	925	146.5	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum
16	Skokomish-Dosewallips	4,068	191	31.7	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Hood Canal Summer-Run Chum	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Hood Canal Summer-Run Chum
17	Quilcene-Snow	6,616	380	65.6	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Hood Canal Summer-Run Chum	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Hood Canal Summer-Run Chum
18	Elwha-Dungeness	4,518	156	35.6	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum	Puget Sound/Strait of Georgia; Puget Sound Chinook; Puget Sound Steelhead; Odd Year Pink Salmon; Puget Sound/Strait of Georgia Chum

19	Lyre-Hoko	12,799	516	86.2	Olympic Peninsula Coho; Washington Coast Chinook; Olympic Peninsula Steelhead; Pacific Coast Chum	Olympic Peninsula Coho; Washington Coast Chinook; Olympic Peninsula Steelhead; Pacific Coast Chum
20	Soleduc	29,854	1318	180.8	Olympic Peninsula Coho; Washington Coast Chinook; Lake Ozette Sockeye; Olympic Peninsula Steelhead; Pacific Coast Chum	Olympic Peninsula Coho; Washington Coast Chinook; Lake Ozette Sockeye; Olympic Peninsula Steelhead; Pacific Coast Chum
21	Queets-Quinault	10,147	352	50.4	Olympic Peninsula Coho; Washington Coast Chinook; Quinault Lake Sockeye; Olympic Peninsula Steelhead; Pacific Coast Chum	Olympic Peninsula Coho; Washington Coast Chinook; Quinault Lake Sockeye; Olympic Peninsula Steelhead; Pacific Coast Chum
22	Lower Chehalis	52,293	1379	254.6	Washington Coast Chinook; Washington Coast Steelhead; Pacific Coast Chum	Washington Coast Chinook; Washington Coast Steelhead; Pacific Coast Chum
23	Upper Chehalis	48,345	1950	441.6	Washington Coast Chinook; Washington Coast Steelhead; Pacific Coast Chum	Washington Coast Chinook; Washington Coast Steelhead; Pacific Coast Chum
24	Willapa	56,707	1967	400.1	Washington Coast Chinook; Pacific Coast Chum; Washington Coast Steelhead; LCR Coho; LCR Chinook; Upper Willamette River Chinook; Upper Willamette River Steelhead; Columbia River Chum Middle Columbia River Spring Chinook; Mid Columbia River Steelhead; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead; Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead	Washington Coast Chinook; Pacific Coast Chum; LCR Coho; LCR Chinook; Washington Coast Steelhead

25	Grays/Elochoman	20,654	986	211.6	Washington Coast Steelhead; Upper Willamette River Chinook; Upper Willamette River Steelhead; LCR Coho; LCR Chinook; Columbia River Chum; Middle Columbia River Spring Chinook; Mid Columbia River Steelhead; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead; Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead	LCR Coho; LCR Chinook; Washington Coast Steelhead; Columbia River Chum; Upper Willamette River Chinook; Upper Willamette River Steelhead
26	Cowlitz	60,387	3193	541.6	Upper Willamette River Chinook; Upper Willamette River Steelhead; LCR Coho; LCR Chinook; Columbia River Chum; Middle Columbia River Spring Chinook; Mid Columbia River Steelhead; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead; Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead	Upper Willamette River Chinook; Upper Willamette River Steelhead; LCR Coho; LCR Chinook; Columbia River Chum
27	Lewis	28,540	1573	272.9	LCR Coho; LCR Chinook; Columbia River Chum; Middle Columbia River Spring Chinook; Mid Columbia River Steelhead; Middle Columbia River Spring Chinook; Mid Columbia River Steelhead; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead; Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead	Upper Willamette River Chinook; Upper Willamette River Steelhead; LCR Coho; LCR Chinook; LCR Steelhead; Columbia River Chum

28	Salmon-Washougal	10,196	370	82.5	Upper Willamette River Chinook; Upper Willamette River Steelhead; LCR Coho; LCR Chinook; LCR Steelhead; Columbia River Chum; Middle Columbia River Spring Chinook; Mid Columbia River Steelhead; Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead	Upper Willamette River Chinook; Upper Willamette River Steelhead; LCR Coho; LCR Chinook; LCR Steelhead; Columbia River Chum
29	Wind-White Salmon	10,751	516	124.5	LCR Coho; LCR Chinook; LCR Steelhead; Columbia River Chum; Middle Columbia River Spring Chinook; Mid Columbia River Steelhead; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead; Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead	LCR Coho; LCR Chinook; LCR Steelhead; Columbia River Chum
30	Klickitat	10,301	369	83.9	Middle Columbia River Spring Chinook; Mid Columbia River Steelhead; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead; Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead	Middle Columbia River Spring Chinook; Mid Columbia River Steelhead
31	Rock-Glade	2,298	50	10.2	Middle Columbia River Spring Chinook; Mid Columbia River Steelhead; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead; Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead	Middle Columbia River Spring Chinook; Mid Columbia River Steelhead

32	Walla Walla	3,548	182	60.1	Middle Columbia River Spring Chinook; Mid Columbia River Steelhead; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead; Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead	Middle Columbia River Spring Chinook; Mid Columbia River Steelhead
33	Lower Snake	0	0	0.0	Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead; Snake River Sockeye	Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead; Snake River Sockeye
34	Palouse	397	1	2.4		
35	Middle Snake	1,537	41	18.8	Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead; Snake River Sockeye	Snake River Fall Chinook; Snake River Spring/Summer Chinook; Snake River Spring/Summer Chinook; Snake River Basin Steelhead; Snake River Sockeye
36	Esquatzel Coulee	0	0	0.0	Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead;	Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead;
37	Lower Yakima	1,989	126	24.8	Upper Columbia River Summer/Fall Chinook; Mid Columbia River Spring Chinook: Mid Columbia River Steelhead;	Mid Columbia River Spring Chinook: Mid Columbia River Steelhead
38	Naches	2,763	149	38.2	Upper Columbia River Summer/Fall Chinook; Mid Columbia River Spring Chinook; Mid Columbia River Steelhead;	Mid Columbia River Spring Chinook; Mid Columbia River Steelhead

39	Upper Yakima	11,805	468	122.7	Upper Columbia River Summer/Fall Chinook; Mid Columbia River Spring Chinook; Mid Columbia River Steelhead;	Mid Columbia River Spring Chinook; Mid Columbia River Steelhead
40	Alkali-Squilchuck	1,503	88	12.7	Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead;	
41	Lower Crab	2	0	0.0	Upper Columbia River Summer/Fall Chinook	
42	Grand Coulee	26	0	0.0		
43	Upper Crab-Wilson	93	1	0.4		
44	Moses Coulee	57	2	0.3		
45	Wenatchee	5,794	325	71.6	Lake Wenatchee Sockeye; Upper Columbia River Spring Chinook; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead	Lake Wenatchee Sockeye; Upper Columbia River Spring Chinook; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead
46	Entiat	1,327	48	18.3	Upper Columbia River Spring Chinook; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead	Upper Columbia River Spring Chinook; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead

47	Chelan	486	10	6.4	Upper Columbia River Summer/Fall Chinook	Upper Columbia River Summer/Fall Chinook
48	Methow	1,675	51	12.9	Upper Columbia River Spring Chinook; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead	Upper Columbia River Spring Chinook; Upper Columbia River Summer/Fall Chinook; Upper Columbia River Steelhead
49	Okanogan	6,779	161	51.0	Okanogan River Sockeye; Upper Columbia River Spring Chinook; Upper Columbia River Steelhead	Okanogan River Sockeye; Upper Columbia River Spring Chinook; Upper Columbia River Steelhead
	Totals	**593,428**	**25,260**	**5,345.5**		
	Totals attributable to the 20-acre exemption rule (2.5 percent of total)	**14836**	**632**	**134**		

Sediment. Sediment inputs will be either chronic or acute. Chronic sediment inputs will occur at low levels at all locations where roads cross streams and are adjacent to streams. Sediment inputs will also occur from the continuing use of these roads throughout the term of the FPHCP. Chronic input is expected to decline over the life of the permit as FPHCP measures and projects addressing the effects of stream adjacent roads are completed (road decommissioning and stream-crossing improvements).

In contrast to chronic input, instances of acute sediment input will occur during and immediately after road decommissioning work on stream-adjacent roads and stream-crossing improvements or replacements. Road decommissioning is expected to occur in all stream types. Furthermore, timber harvest within the riparian areas adjacent to type N streams could decrease or eliminate the sediment capturing capacity of riparian areas until subsequent riparian revegetation regains the capture function, and thus enables sediment input to streams.

Acute sediment input will harm low numbers of juvenile lifestages of river-type Chinook, steelhead, and coho, which reside in riverine systems throughout the year. Adults of these species would 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 crossing or decommissioning work is anticipated to be low wherever effects arise because the proposed action includes measures to reduce the extent of effects and fish exposure (worksite isolation, restricted work timing, and ordinary brief persistence of turbid conditions).

The action area contains road crossings of fish-bearing streams at about 18,000 locations. The action area has an additional 9,000 road crossings of perennial non-fish-bearing streams. Each of these crossings will be replaced or upgraded at least once during the 50 year term of the FPHCP. Each replacement or upgrade will most likely include some amount of in-water work. The downstream extent of turbidity (the physical area where harm from turbidity is most likely to occur) is influenced by the size and velocity of the waterbody. Thus, for worksites in streams with flows not exceeding 10 cubic feet per second, the exemption from the take prohibition would cover turbidity up to but not beyond 100 feet downstream from the worksite. For streams with flows between 10 and 100 feet per second, the take exemption would cover turbidity up to but not beyond 200 feet downstream of the worksite. Finally, for streams with flows more than 100 cubic feet per second, the take exemption would reach but not extend beyond 300 feet downstream from the worksite.

Acute turbidity will not harm juvenile chum and ocean type Chinook in fish bearing streams, as work timing restrictions will focus work of this type during times when the juveniles will not be present. Juvenile fish might be harmed by acute sediment input from riparian timber practices near Type N streams, but the extent of harm would be low because turbidity will decrease as the water from the Type N streams reaches fishbearing waters. The type harm would be in the form of temporary distress fish (injury). Acute sediment loading from riparian timber practices will likely last through the first growing season following the timber practice.

Riparian Vegetation. Reduced riparian vegetation is expected at all road crossings that block or impede fish passage at the time that the blockage is repaired or the crossing is replaced. Reduction in riparian vegetation is also expected from timber harvest and related activities within the riparian areas adjacent to type N streams. Reduced riparian vegetation diminishes habitat value in a variety of ways described in the effects analysis, earlier in the document, including water quality (increased temperature from decreased shade) and less available large wood to recruit instream. Absent replanting, reduced shade and cover are expected to persist for several years at each site where riparian vegetation is removed. When replanting occurs in the riparian area, lost shade and cover begin to return within several years, but do not recover to full function for many years. Detrital input recovers more quickly than do shade and cover functions.

Large Woody Debris. Low rates of large woody debris recruitment will persist throughout the action area where riparian harvest occurred under previous forest practices regulations. These conditions will improve with time during the term of the proposed ITP on all streams except type N streams, where timber harvest is allowed in the riparian area. The effect of less large wood to recruit from type N streams can affect fish bearing waters downstream; without large wood to contribute to the processes that make and maintain habitat complexity in fishbearing streams, the rate at which streams recover from the shortage of recruitable large wood will be slower, exposing more fish to simplified habitat, for a longer period of time. Harm from this source is expected to manifest as injury, but not as death, since the effects are not as acute below the confluence of type N streams with fish bearing streams.

Water Temperature. Riparian harvest will also reduce shade on type N streams, in fish-bearing streams in isolated locations where vegetation is removed for stream adjacent road work or stream crossing work is undertaken, and at the confluence of warm type N waters and receiving fish-bearing waters. Type N streams with low discharge may be warm, but their ability to affect the temperature of downstream receiving waters is a function of the relative size of the receiving waterbody. For example, streams of moderate discharge, contributing more than about 20 percent to downstream fishbearing receiving waters would be relatively rare, but such a stream may have some potential to alter temperature regimes. Conversely, type N streams of significant discharge and velocity are less likely to be warm while passing though a harvest unit. Additional factors in the ability of type N streams to affect the temperature of fishbearing streams include site-specific qualities such as velocity, depth, and substrate of the receiving water body. Thus, take from warm water temperatures is expected to be limited to small areas at the confluence of type N and fish-bearing streams.

Worksite Isolation /Dewatering. Worksite isolation typically reduces the number of fish exposed to construction activities and can reduce the extent of certain construction-related habitat effects. Nevertheless, these procedures themselves can alter fish behavioral patterns, injuring or killing some fish. Dewatering work areas for work that will be conducted within the wetted perimeter of type S and type F streams (i.e., upgrading road crossings at approximately 18,000 streams) can strand fish. Even though dewatering of worksites will take place in most of these stream crossings during the term of the HCP, the numbers of fish that are expected to strand or smother from dewatering and worksite isolation is low because herding and restricting re-entry removes most fish prior to dewatering. Eggs and alevins are not expected to be present during work windows associated with this type of in-water work.

20-acre Exemption Parcels. Quantifying incidental take under the 20-acre exemption rule is difficult because of the lack of consistent statewide data on forested parcel ownership. However, the Services performed a coarse analysis (Appendix B) to compare the number of acres harvested annually on 20-acre-exemptiom parcels to all covered FPHCP lands. Based on this analysis, 2.5 percent of the total annual incidental take on FPHCP lands can be attributed to the 20-acre exemption rule.

Injury or Death. Take in the form of injury or death is expected from electrofishing during worksite isolation activities. As stated above, worksite isolation is prescribed for certain in-water work. Worksite isolation reduces the number of fish exposed to construction effects, thus minimizing the effects of the action. Electrofishing isolated water as sites are dewatered is prescribed to identify residual fish in the isolated area so that they can be captured and released outside of the isolated worksite. While this technique is prescribed to minimize the effects of the action, the process can injure or kill fish.

Electrofishing. When electrofishing occurs in type S and type F streams, either as a work-area isolation technique, or in the context of monitoring, injury or death is expected. Spinal and/or hemorrhage injuries from electofishing could affect up to 37 percent of fish found in dewatered stream segments (Thompson et al., 1997; Hollender and Carline 1994). Mortality, either instant or delayed, normally occurs in one to two percent of all fish shocked during electrofishing. Numbers of fish that are anticipated to be electrofished for worksite isolation at the approximately 18,000 stream crossings is expected to be very low at all locations because the routine isolation techniques include herding fish out of, and blocking re-entry to work areas before electrofishing takes place. Only juvenile steelhead, river-type Chinook, and coho are expected to be present in the reaches where in-water work will require electrofishing, as authorized work windows are designed to accommodate outmigration of juvenile ocean-type Chinook and chum. Electrofishing associated with model validation will occur in less than one percent of streams. When fish are discovered, model-validation work would cease; and, therefore, electrofishing would be expected to occur on those streams only once during the life of the permit (50 years). When fish are not discovered, model validation or updating may occur at five-year intervals throughout the term of the HCP.

Not all species present in a WRIA will suffer take. A species must be present, and the specific life history stage must be vulnerable, in a given locale for take from harm, injury and/or death to occur. The most vulnerable lifestages are eggs and alevins, which are not mobile and cannot avoid take-causing conditions. Because authorized work windows are primarily designed to protect the most vulnerable lifestages, and because adult fish have the capacity to swim to alternate locations to avoid many conditions that create harm, such as turbidity, reduced food-source, or lack of cover, it is those juvenile fish that residualize in the areas where work is occurring that are likely to be taken. Take of resident fish, even juveniles, is even less likely to occur in the largest water bodies, such as the Columbia River, where the conditions that could otherwise cause take are quickly dissipated by the large volume of water.

2.2.2 Reasonable and Prudent Measures

The applicant will minimize the extent of incidental take by implementing the following Term and Condition.

2.2.3 Term and Condition

All conservation measures described in the final FPHCP (WDNR 2006), together with the associated Implementation Agreement and the section 10(a)(1)(B) permit issued with respect to the FPHCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement. Such terms and conditions are non-discretionary 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 under the proposed HCP, associated reporting requirements, and provisions for disposition of dead or injured animals are as described in the HCP and its accompanying section 10(a)(1)(B) permit.

2.3 Endangered Species Act section 10(a) Statement of Findings

Section 10(a)(2)(B) Issuance Considerations. In determining whether to issue a permit, the Assistant Administrator will consider the following:

(i) *The status of the affected species or stocks*. NMFS evaluated the status of all species to be included in the HCP. The status of covered listed and unlisted species is described at section 2.1.1 of the Biological Opinion, above. The baseline conditions of the action area covered by the HCP were also considered, and the evaluation can be found at section 2.1.3 of the Biological Opinion.

(ii) *The potential severity of direct, indirect, and cumulative impacts on the species or stocks and habitat as a result of the proposed activity.* The Biological Opinion includes NMFS's analysis of effects to species that are covered by the HCP, as well as an analysis of effects to the designated critical habitat of species currently listed under the ESA. The effects analysis evaluated the direct and indirect effects of activities covered by the HCP, (see Biological Opinion section 2.1.4). NMFS also evaluated the cumulative effects from other non-federal activities that are reasonably likely to occur in the action area (*id* at 2.1.6).

(iii) *The availability of effective monitoring techniques*. The Forest and Fish Account, established by Senate Substitute Bill 6874, is designed to provide adequate funding for adaptive management and monitoring of the implementation of the Forest and Fish Report (FFR). The FFR was a foundational document for the Forest Practices Rules that are implemented under the HCP. The 2006 Supplemental Budget includes almost $400,000 for wildlife assessments on Forest and Fish lands, with field audits, undertaken by the WDNR Forest Practices Division, intended to ensure proper HCP implementation. The Forest and Fish Account is funded by a surcharge on the Business and Occupation tax on the forestry sector; the account and surcharge are to be in place until 2024. Therefore, effective monitoring appears to be securely funded for the first 20 years of the HCP. Monitoring of HCP implementation and the effectiveness of the HCP prescriptions is a critical feature of this HCP. Monitoring reports will be completed and submitted to the Services according to the schedule described in Table 1.1 of the HCP. The frequency and period of monitoring varies by plan element, with compliance and effectiveness monitoring of key items extending throughout the entire 50-year term of the plan.

(iv) *The use of the best available technology for minimizing or mitigating impacts.* The prescriptions established in this HCP represent the most recent developments in science and technology in minimizing and mitigating impacts to riparian and aquatic habitats, from the avoidance of timber harvesting on unstable slopes to Road Maintenance and Abandonment Plans (RMAPs). Further, the adaptive management component (the Cooperative Monitoring, Evaluation, and Research program) of this HCP assures new science and technology will continue to be employed in the HCP as it is implemented.

(v) *The views of the public, scientists, and other interested parties knowledgeable of the species or stocks or other matters related to the application.* The Services solicited the views of the public, including scientists and other interested parties, when they formally initiated environmental review of the project through a Notice of Intent (NOI) to prepare an Environmental Impact Statement in the Federal Resister on March 17, 2003 (68 FR 12676). This NOI also announced a 30 day public scoping period, during which other agencies, tribes, and the public were invited to provide comments and suggestions regarding issues and alternatives to be included in the EIS.

The NOI indicated the dates times and locations of four public scoping meetings to be held across the state. These meetings were also announced through (1) a press release issued by the Services on March 10, 2003, and (2) electronic mail announcements sent to individuals listed on the WDNR Forest Practices Division's "Meeting Agenda" and "Meeting Notices" lists. The public meetings included informal and formal presentations. A variety of informational material related to the proposed action was made available to attendees.

A Notice of Availability on February 11, 2005 (70 FR 7245) opened a 90-day public comment period on the Draft EIS and Draft FPHCP subsequently produced. These documents were filed with the Environmental Protection Agency (70 FR 7256). Availability of both drafts was also announced through a press release issued by the Services, and copies of the documents with reviewer/commenter instructions were mailed to individuals listed on the WDNR Forest Practices Division's "Meeting Agenda" and "Meeting Notices" lists, and individuals who had expressed interest in the project. During the comment period, 743 comment letters were received. A comment letter response team was formed of individuals from the USFWS and NMFS. Input was also sought on technical comments related to the

State's Draft FPHCP application from the U.S. Environmental Protection Agency (EPA), WDNR, Washington Department of Ecology (Ecology), and the Washington Department of Fish and Wildlife (WDFW).

Primary issues raised in the comments related to the Endangered Species Act, EIS process and EIS alternatives, technical issues about the proposed action, economics, and Tribal and cultural issues. Many of the comments and suggestions were incorporated into the Final FPHCP and Final EIS. Volume II of the Final EIS contains a summary of comments received on the draft documents and the Services' responses, including a description of changes made to the HCP and EIS.

The Final EIS and Final FPHCP were subsequently produced and filed with the Environmental Protection Agency (71 FR 4578), and made available for a 30 day public comment period through a Notice of Availability published on January 27, 2006 (71 FR 4609). Their availability was also announced through a press release issued by the Services, and copies of the documents with reviewer/commenter instructions were mailed to individuals listed on the WDNR Forest Practices Division's "Meeting Agenda" and "Meeting Notices" lists and to individuals who had expressed interest in the project. During the review period 10 comment letters were received and are attached as Appendix B to the Record of . A review of the comments revealed that a majority of the issues had been raised in comments on the Draft EIS and Draft FPHCP, and had been addressed in the preparation of the Final EIS, including Volume II: Response to Comments, and the Final HCP. The remainder of the comments were factored into NMFS' decision-making process.

Section 10(a)(2)(B) Issuance Findings. Having considered the above, NMFS must make certain findings under section 10(a)(2)(b) of the ESA, with regard to the adequacy of the HCP meeting the statutory and regulatory requirements for an Incidental Take Permit under section 10(a)(1)(B) of the ESA and 50 CFR section 222.307. To issue the permit, NMFS must find that:

(i) *The taking will be incidental.* NMFS concluded in its Biological Opinion that take in the form of harm is likely to occur incidentally to the timber harvest and related practices covered by the HCP. Harm is the significant modification of habitat that impairs the listed species' behavior patterns (breeding, feeding, and sheltering) in such a way as to cause injury or death. Timber practices, and the maintenance, improvements, and decommissioning of roads infrastructure that support timber practices will clearly affect fish habitat, as described in the effects analysis above, but are not intended to kill, injure, or harm fish. Thus, NMFS finds that any take that occurs is incidental to the activities authorized under the HCP.

(ii) *The applicant will, to the maximum extent practicable, monitor, minimize, and mitigate the impacts of such taking.* NMFS finds that the State and landowners and operators to whom the Permit coverage extends will minimize and mitigate the impacts of take of the Covered Species to the maximum extent practicable. Under the provisions of the FPHCP, the impacts of take will be minimized, mitigated, and monitored in accordance with the requirements of the Permit through the following measures:

(a) Incorporation of the current State Forest Practices Regulatory Program and Rules (described in the Conservation Strategy section above).

(b) Establishment of State Forest Practices Regulatory Program refinement procedures that occur through an adaptive-management process. Adaptive management is designed to assess the effectiveness of the protection measures in achieving established resource objectives. It also includes programs to monitor the status and trends of key environmental parameters and to evaluate watershed-scale cumulative effects (described in the Conservation Strategy section above).

(c) The ability and commitment of the Permittee to ensure funding to fully implement the FPHCP, the IA and the Permit. (described below).

The minimization and mitigation measures proposed by the State were developed based on the 1999 FFR, the forestry module of a larger comprehensive statewide effort to protect aquatic species, their habitats, and water quality. The NMFS and FWS participated in FFR negotiations as it was the intent of the State legislature that adoption of FFR would satisfy the regulatory requirements of the ESA. The FFR process, together with input through the public Section 10/NEPA process, allowed NMFS to consider the types of conservation necessary to avoid and/or address impacts within the Action Area, and the ability of the State to implement prescriptions and procedures that are practicable in the context of their regulation of forest practices activities on 9.3 million acres of non-Federal, non-Tribal forest lands in Washington State.

NMFS views the FPHCP, like most other habitat-based conservation plans, as having integrated its minimization and mitigation measures with the other activities for which the applicant seeks incidental take authorization. In other words, the environmental effects of covered activities are, for the most part, not identifiable separately from the effects of measures intended to minimize those effects. A site-scale example of such integration is the designation of protective buffers of unharvested trees around certain ecological features used by Covered Species. Incidental take does not result from the leaving of an unharvested buffer. Instead, leaving the buffer minimizes the effects of other harvest within the landscape in which the harvest occurs. However, it is important to remember that the assessment of whether this criterion for issuance of an ITP has been met is conducted for the plan as a whole, not for individual activities or measures.

The specific FPHCP minimization and mitigation measures are found in Chapter 4 of the FPHCP, Chapter 2 of the FEIS, and in the Biological Opinion's Description of Proposed the Action (section 1.2). These measures include two prongs: an administrative framework and protection measures. The protection measures are comprised of two two parts; a riparian conservation strategy and an upland conservation strategy. The conservation objective of the riparian strategy is to protect riparian habitat function on lands covered by the FPHCP and to and enable improvement of those levels once they are attained (WAC 222-30-010(2)). Riparian functions include large-wood recruitment, sediment filtration, streambank stability, shade, litterfall and nutrients, in addition to other processes important to riparian and aquatic systems.

The approach to restoring riparian function differs for different parts of the State. In western Washington, protection measures place riparian forests on growth trajectories toward a DFC, which is defined as the condition of a riparian forest stand at 140 years of age. In eastern Washington, protection measures are intended to provide for stand conditions that vary over time. Varying stand conditions are designed to mimic natural disturbance regimes within a range that meets resource objectives and maintains general forest health. Further, the riparian strategy from the FPHCP consists of three separate but related sets of protection measures:

- Riparian and wetland management zones that provide large-wood recruitment, shade, and other ecological functions through tree retention.

- Limitations on equipment use in and around waters and wetlands to minimize erosion and sedimentation and maintain hydrologic flowpaths.

- Streamside land and timber acquisitions for the long-term conservation of aquatic resources.

The goal of the upland strategy is to prevent, avoid, minimize, or mitigate forest practices-related changes in erosion and hydrologic processes and the associated effects on public resources. The upland strategy in the FPHCP consists of protection measures that are implemented in upslope areas outside RMZs and wetlands. These measures are intended to limit forest practices-related changes in physical watershed processes, such as erosion and hydrology that may adversely affect the quality and quantity of riparian and aquatic habitat lower in the watershed. The upland strategy includes Washington Forest Practices Rules, guidance from the Forest Practices Board Manual, and guidance issued through the WDNR Forest Practices Division related to unstable slopes and landforms; the location, design, construction, maintenance, and abandonment of forest roads; and harvest-induced changes in rain-on-snow peak flows. Specific objectives of some of the protection measures of the upland conservation strategy are found in the FFR (FPHCP Appendix B) and the Washington Forest Practices Rules. Section 4c of the FPHCP lists measures that cover unstable slopes/mass wasting, forest roads, and hydrology.

Further, the effectiveness and validation monitoring component of the FPHCP (as described in Section 4a-4.2 of the FPHCP) is designed to evaluate the degree to which the Washington Forest Practices Rules and guidance meet performance targets and resource objectives. Validation monitoring will determine if the performance targets are appropriate for meeting the stated resource objectives. The CMER Committee has identified 15 effectiveness and validation monitoring programs (FPHCP Appendix H). Each program has several associated projects, some of which are currently underway, while others have not yet reached the scoping phase.

As described in the Services' Record of Decision (NMFS and USFWS 2006), several alternatives to the proposed action, were considered, and the proposed FPHCP was selected as the environmentally preferred alternative. This alternative, together with the IA, and specific provisions and conditions of the ITP, provides the most long-term protection and conservation for riparian and aquatic habitat for Covered Species. NMFS expects the FPHCP alternative to have the most participation by Forests and Fish stakeholders as compared with all other alternatives. NMFS also expects the FPHCP alternative to receive the most State and other funding under the FPHCP, as compared with all other alternatives.

NMFS has approved a number of forest-related HCPs since 1996 that address fish. Cautious comparisons can be made between HCPs to inform the assessment of whether a particular HCP minimizes or mitigates to the maximum extent practicable. However, each HCP is tailored to an applicant's specific objectives and to the conservation needs of each species covered on their permit. The prescriptions in the Plum Creek Native Fish HCP are perhaps the most comparable to the prescriptions in the FPHCP. The Plum Creek Native Fish HCP is no longer in effect in Washington State; however, at the time of issuance, it included lands both east and west of the Cascade crest. The prescriptions in the Plum Creek Native Fish HCP are very similar to the proposed FPHCP and the Plum Creek Native Fish HCP also includes an adaptive-management program. Some aspects remain difficult to compare, for instance, the Plum Creek Native Fish HCP provides protective measures with respect to grazing and land disposition and covered lands in three different States. However, as stated in the response to comments in the FEIS for the Native Fish HCP (NMFS and USFWS 2000) "The Services have determined that the riparian and road measures of the NFHCP and FFR provide similar conservation benefits."

Finally, NMFS included specific, nondiscretionary terms and conditions in the ITP that were necessary to meet the conservation benefits of the FPHCP and to minimize and mitigate to the maximum extent practicable. Specifically, the permit condition for leave trees on Type Np streams on 20-acre exempt parcels was necessary to meet the conservation benefits of the FPHCP and to minimize and mitigate to the maximum extent practicable.

In consideration of all the above facts, NMFS finds that: (a) the mitigation is commensurate with the impacts; (b) the FPHCP is consistent with the long-term survival and recovery of Covered Species (also see (iii) below); and (c) the FPHCP minimizes and mitigates the effects of take to the maximum extent practicable. These findings are based on the fact that benefits to the species will be demonstrable, especially compared to existing conditions or those conditions expected to occur absent the FPHCP.

(iii) *The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild*. NMFS, using the best available science, has evaluated the anticipated extent of take that will be incidental to the practices covered by the HCP, throughout the term of the HCP (summarized in section 2.1.7 of the Biological Opinion, above), and has concluded that the incidental takings likely to occur will not appreciably reduce the likelihood of survival and recovery. This conclusion can be found at section 2.1.8 of the Biological Opinion. The section 7(a)(2) "no jeopardy" standard is identical to the section

10(a)(2)(B) standard.

(iv) *The applicant has amended the conservation plan to include any measures (not originally proposed by the applicant) that the Assistant Administrator determines are necessary or appropriate.* NMFS identified several additional conservation measures that are necessary or appropriate and conditioned the Incidental Take Permit to include these measures as "Specific Conditions" 1 through 6. The FPHCP, Implementation Agreement, and Incidental Take Permit incorporate all elements determined by NMFS to be necessary for approval of the FPHCP and issuance of the permit. Details of the following items are in the ITP.

(v) *There are adequate assurances that the conservation plan will be funded and implemented, including any measures required by the Assistant Administrator*. NMFS finds that the Permittee will ensure funding adequate to implement the FPHCP. The following mechanisms were considered that demonstrate the State has the ability and commitment to fully implement the FPHCP, the IA and the Permit:

Historical and Near-Term Financial Backing: Summaries of State funding appropriated for biennial budget years 2001-2003, 2003-2005, and 2005-2007 are provided in Tables 8, 9, and 10 (below). Adequate resources are essential to the Adaptive Management Program. The primary method to provide adequate resources is to obtain adequate funding. The State has committed three million dollars over the last five years to the Adaptive Management Program (since the implementation of the current Washington Forest Practices Rules in effect since January 1, 1999). The Federal government has also provided approximately four million dollars per year for the past six years to the Adaptive Management Program. The Federal funds are primarily used for CMER research. Some of the funds enable WDOE and WDFW to fully participate in the Adaptive Management Program. While appropriations of State funding are solely within the discretion of the Washington State Legislature, NMFS notes that the legislature passed the Forests and Fish Law (Special Session 1999 ESHB 2091, RCW 76.09.370) directing the Forest Practices Board to adopt permanent Rules representing the recommendations of the FFR, including Adaptive Management, and requiring that an HCP be pursued.

Table 8 depicts State appropriations provided for the processing, reviewing, and making decisions on forest practices applications and notifications. Staff conduct forest practices compliance and enforcement activities, as well as brief adjudicated processes for appealing Notices to Comply. The Forest Practices Program develops and issues forest practices operational guidance; reviews and approves road maintenance and abandonment plans; supports the Forest Practices Board; and develops and updates the Forest Practices Board Manual and Rules affecting small forest landowners.

Table 8: Appropriations for Forest Practices Act and Rules

Appropriation Period	General Fund, State (in $)	All Other Funds (in $)	Full Time Employees	Total (in $)
2001-2003	16,218,517	2,786,426	141.9	19,004,943
FY 2004	11,977,000	1,019,000	139.6	12,996,000
FY 2005	9,006,000	1,040,000	137.5	10,046,000
FY 2006	11,028,000	419,000	132.0	11,447,000
FY 2007	11,258,000	991,000	134.0	12,249,000

State of Washington, Office of Financial Management, "Agency Activity Summary," http://www.ofm.wa.gov/budget/manage/default.asp, accessed on May 25, 2006. All Other Funds includes State and non-State funding sources.

Table 9 depicts State appropriations provided for the Forest Practices Adaptive Management Program that manages CMER projects. The research is used to improve the administration and effectiveness of forest practice rules.

Table 9: Appropriations for Forest Practices – Manage Adaptively

Appropriation Period	General Fund, State (in $)	All Other Funds (in $)	Full Time Employees	Total (in $)
2001-2003	1,272,585	66,000	3.0	1,228,585
FY 2004	527,000	93,000	8.3	620,000
FY 2005	533,000	93,000	8.3	626,000
FY 2006	638,000	3,000	4.5	641,000
FY 2007	638,000	3,000	4.5	641,000

State of Washington, Office of Financial Management, "Agency Activity Summary," http://www.ofm.wa.gov/budget/manage/default.asp, accessed on May 25, 2006. All Other Funds includes State and non-State funding sources.

Table 10 depicts State appropriations provided for the Small Forest Landowner Office. This office helps small forest landowners meet the requirements of the Forest and Fish Act. Activities also include administering the Riparian Easement Program, providing technical assistance to family forest owners, supporting the Small Forest Landowners Office's Advisory Committee, and supporting the Forest Practices Board's Family Forest Joint Policy Technical Task Force.

Table 10: Appropriations for Small Forest Landowner Office

Appropriation Period	General Fund, State (in $)	All Other Funds (in $)	Full Time Employees	Total ($1)
2001-2003	987,187	597,775	9.9	1,584,692
FY 2004	501,000	82,000	8.8	583,000
FY 2005	510,000	82,000	8.3	592,000
FY 2006	8,000	547,000	5.9	555,000
FY 2007	8,000	588,000	5.9	596,000

State of Washington, Office of Financial Management, "Agency Activity Summary," http://www.ofm.wa.gov/budget/manage/default.asp, accessed on May 25, 2006. All Other Funds includes State and non-State funding sources.

Note: Tables 9 and 10 are separate funding allocations and are not subsets of Table 8.

The State appropriated funding does not include the in-kind contributions associated with stakeholder participation in the Adaptive Management Program, forgone landowner revenue associated with more-protective forest practices rules, and direct landowner operating expenses incurred developing and implementing RMAPs. That cost is estimated to be approximately $200 million (as of November 2005) forgone and spent by landowners each year (Weiss, pers. comm. May 26, 2006). This estimate was partially based on an internal WFPA analysis (on riparian buffers and unstable slope protections) done during the FFR negotiations and presented to the legislature. A discounted cash flow approach was used to estimate regional values for an acre of land and timber. This was multiplied by regional estimates of land inside riparian and unstable slope buffers. Allowances were made for partial harvest in the inner and outer riparian buffers. Two percent of the landscape was assumed to be set aside for steep and unstable slope protections. The remainder of the $200 million estimate, for operational and road costs, was based on a Cost Benefit Analysis (Perez-Garcia 2001). The net result is a net present value impact of over $3.5 billion to landowners, or nearly $200 million per year, if annualized.

The Cost Benefit Analysis estimate actually came up with higher overall costs for riparian buffers, but not all costs would be incurred by landowners. WFPA felt that the Cost Benefit Analysis overestimated the cost of riparian buffers. Further, the Cost Benefit Analysis did not estimate the cost for unstable slope protections.

Future Funding: Section 7.1 of the IA binds the State to promptly notify NMFS of any appreciable reduction in available funding below the amount expended in the 2003-05 Biennium for administration of the Department of Natural Resources' forest practices regulatory program, measured in 2005 dollars, or any material change in its financial ability to fulfill its obligations under the FPHCP. The State will cooperate with NMFS to the extent possible in order to minimize any adverse effects of such changes on achievement of the conservation goals of the FPHCP.

In addition, the State Legislature made two significant steps in securing long-term funding for implementation of the FPHCP. First, the State supplemental budget includes an appropriation of $2.5 million for the sole purpose of supporting Tribal involvement in Forests and Fish for State FY 2007. This appropriation would lapse if the Federal government were to provide funding to the Tribes for this effort. Second, Substitute Senate Bill 6874 was signed by the Governor on March 29, 2006. Section 2 of the bill adds a surcharge of 0.052 percent to the Business and Occupation Tax imposed on the forestry sector to be deposited in an account created in the bill. It is called the "Forest and Fish Support Account", created in the State Treasury. Expenditures from the account shall be used for activities related to the State's implementation of the Forests and Fish Report, including, but not limited to, Adaptive Management, Monitoring, and participation grants to Tribes, State and local agencies, and not-for-profit public interest organizations. There are provisions for suspending the tax surcharge under a few conditions that would mean either other funding or enough funding is available. This account is a dedicated account; expenditures are subject to appropriation by the Legislature. The account and tax surcharge will be in place until 2024. The surcharge is expected to generate almost $4 million per year based on estimates from recent data. This revenue is anticipated to grow through time. However, if forest-related activity levels decline, revenue could subsequently decline as well.

Collaboration: The State Legislature is likely to continue funding the FPHCP adequately because a broad range of citizens and interest groups state-wide have a strong stake in ensuring the plan's viability. Stakeholders who developed FFR and who participate in its implementation under the Washington Forest Practices Rules include traditionally competing interests (caucuses) who are now mutually dependent upon one another for its success. If one caucus were to fail to support funding for the Adaptive Management Program or otherwise frustrate the program by lack of participation, it is reasonable to assume another would ensure that the consequences of that failure are well known and thoroughly considered by policy-makers at all levels, including members of the Forest Practices Board. Non-compliance with the provisions of the FPHCP, whether caused by a lack of adequate funding or otherwise can give rise to the suspension or revocation of the ITP (further described below).

Suspension or Revocation: Another basis for concluding that the State will ensure adequate funding for the plan is that the State and covered timber operators could lose the permit if funding is not provided. Sections 6.2 and 7.2 of the IA provide that NMFS may suspend or revoke the Permit if the State fails to provide adequate funding. Section 7.1 of the IA requires the State notify NMFS of any appreciable reduction in available funding below the most-recent level appropriated for the forest practices program.

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3.0 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The consultation requirement of Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions, or proposed actions that may adversely affect EFH. Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that may be taken by the action agency to conserve EFH.

The Pacific Fishery Management Council (PFMC) designated EFH for Pacific groundfish (PFMC 2005), coastal pelagic species (PFMC 1998), and Pacific salmon (PFMC 1999). The proposed action and covered area are detailed above in Section 1.2 of this document as the issuance of an Incidental Take Permit (ITP) under Section 10 of the ESA for the implementation of a habitat conservation plan (HCP) and it's associated Implementing Agreement by the State of Washington. The covered area includes habitats designated as EFH for various life-history stages of Pacific salmon; groundfish; and coastal pelagic species (Table 7). In addition, the covered activities will occur in, or adjacent to, habitats designated as Habitat Areas of Special Concern (HAPC) for Pacific groundfish (PFMC 2005). These HAPCs include estuaries, canopy kelp, seagrasses, rocky reefs, and the coastal waters and substrates of the State of Washington from the mean higher high water line seaward to the three nautical mile boundary of the territorial sea.

Based on information provided in the Forest Practices HCP and the analysis of effects presented in Sections 2.1.4 and 2.1.5 of this document, the proposed action may result in adverse impacts to a variety of habitat parameters important to salmonids. Because the conservation measures included as part of the proposed action to address ESA concerns are adequate to avoid, minimize, or otherwise offset potential adverse effects to the EFH of groundfish and coastal pelagic species in Table 7 no adverse impacts to EFH of those species are anticipated.

The Forest Practices HCP and its associated documents clearly identify anticipated impacts to the EFH for Pacific salmon that are likely to result from the proposed activities and the measures that are necessary and appropriate to minimize those impacts. These effects include delivery of sediments to streams through routine timber harvest activities, road construction, road maintenance, and through catastrophic events such as slope failures that are directly or indirectly related to forest management operations, road construction and repair, and cable- and ground-based movement of logs near and through riparian areas.

NMFS determined that the action will have adverse effects on EFH for Chinook salmon, coho salmon, and Puget Sound pink salmon as follows:

1. Short-term degradation of water quality (turbidity) from road construction, maintenance and culvert replacement activities.

2. Short-term pool-filling and degradation of substrate as unbuffered non-fish-bearing streams receive a short-term delivery of fine sediments.

3. Short-term degradation of water quality (temperature) from reduction in riparian shade during hardwood conversions and riparian management zone.

4. Short-term reduction in the extent of large wood available for recruitment to streams and sediment capture (affecting structural components of instream habitat).

5. Short-term reduction in detrital inputs (affecting food sources) as a result of hardwood conversion activities.

All of these effects influence the ability of affected areas to support salmonid spawning, incubation, larval development, juvenile growth and mobility, and adult mobility. For a more detailed description and analysis of these effects, see Sections 2.1.4 and 2.1.5 of this document.

Essential Fish Habitat Conservation Recommendations

The conservation measures included in the State of Washington's Forest Practices HCP as part of the proposed activities are adequate to avoid, minimize, or otherwise offset the potential adverse effects, described above, from these activities to designated EFH for Chinook salmon, coho salmon, and Puget Sound pink salmon. NMFS understands that the State of Washington intends to implement these conservation measures to minimize potential adverse effects to the maximum extent practicable. Consequently, NMFS has no additional conservation recommendations to make at this time.

Statutory Response Requirement

Federal agencies are required to provide a detailed written response to NMFS' EFH conservation recommendations within 30 days of receipt of these recommendations [50 CFR 600.920(j)(1)]. However, since NMFS did not provide conservation recommendations for this action, a written response to this consultation is not necessary.

Supplemental Consultation

The NMFS must reinitiate EFH consultation if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations [50 CFR 600.920(k)].

Table 7. Species of fishes with designated EFH occurring in Strait of Juan de Fuca.

Groundfish Species	redstripe rockfish *S. proriger*	Dover sole *Microstomus pacificus*
spiny dogfish *Squalus acanthias*	rosethorn rockfish *S. helvomaculatus*	English sole *Parophrys vetulus*
big skate *Raja binoculata*	rosy rockfish *S. rosaceus*	flathead sole *Hippoglossoides elassodon*
California skate *Raja inornata*	rougheye rockfish *S. aleutianus*	petrale sole *Eopsetta jordani*
longnose skate *Raja rhina*	sharpchin rockfish *S. zacentrus*	rex sole *Glyptocephalus zachirus*
ratfish *Hydrolagus colliei*	splitnose rockfish *S. diploproa*	rock sole *Lepidopsetta bilineata*
Pacific cod *Gadus macrocephalus*	striptail rockfish *S. saxicola*	sand sole *Psettichthys melanostictus*
Pacific whiting (hake) *Merluccius productus*	tiger rockfish *S. nigrocinctus*	starry flounder *Platichthys stellatus*
black rockfish *Sebastes melanops*	vermilion rockfish *S. miniatus*	arrowtooth flounder *Atheresthes stomias*
bocaccio *S. paucispinis*	yelloweye rockfish *S. ruberrimus*	
brown rockfish *S. auriculatus*	yellowtail rockfish *S. flavidus*	**Coastal Pelagic Species**
canary rockfish *S. pinniger*	shortspine thornyhead *Sebastolobus alascanus*	anchovy *Engraulis mordax*
China rockfish *S. nebulosus*	cabezon *Scorpaenichthys marmoratus*	Pacific sardine *Sardinops sagax*
copper rockfish *S. caurinus*	lingcod *Ophiodon elongatus*	Pacific mackerel *Scomber japonicus*
darkblotch rockfish *S. crameri*	kelp greenling *Hexagrammos decagrammus*	market squid *Loligo opalescens*
greenstriped rockfish *S. elongatus*	sablefish *Anoplopoma fimbria*	**Pacific Salmon Species**
Pacific ocean perch *S. alutus*	Pacific sanddab *Citharichthys sordidus*	Chinook salmon *Oncorhynchus tshawytscha*
quillback rockfish *S. maliger*	butter sole *Isopsetta isolepis*	coho salmon *O. kisutch*
redbanded rockfish *S. babcocki*	curlfin sole *Pleuronichthys decurrens*	Puget Sound pink salmon *O. gorbuscha*

4.0 DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) ("Data Quality Act") specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Biological Opinion addresses these DQA components, documents compliance with the Data Quality Act, and certifies that this Biological Opinion has undergone pre-dissemination review.

Utility: This document records the results of two interagency consultations, completed under two separate legal authorities. The information presented in this document is useful to a variety of interests including agencies of the Federal government, the State of Washington, private landowners, Indian Tribes, Environmental groups, and the timber industry as represented by the Washington Forest Protection Association, individually and as participants in the Forest and Fish Report Process. The information in this document is also useful to the general public, especially individuals with an interest in the Washington Forest Practices Regulations and activities carried out under those regulations. The information is also useful to the general public as it describes the manner in which public trust resources are being managed and conserved. The information presented in these documents and used in the underlying consultations represents the best available scientific and commercial information and has been improved through interaction with the State and local agencies participating in the underlying action. This information was previously improved through interaction with the public in National Environmental Policy Act environmental reviews.

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

Objectivity: Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01 et seq., and the Magnuson-Stevens Fishery Conservation and Management Act (MSA) implementing regulations regarding Essential Fish Habitat, 50 CFR 600.920(j).

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

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

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

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