UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NMFS Nos.:
FS: 2008/03505
BLM: 2008/03506
BIA: 2008/03507

June 27, 2008

Calvin Joyner
Acting Regional Forester, Region 6
USDA Forest Service
P.O. Box 3623
Portland, Oregon 97208

Edward W. Shepard
Director, Oregon/Washington
USDI Bureau of Land Management
P.O. Box 2965
Portland, Oregon 97208

Stanley Speaks
Regional Director, Northwest Region
Bureau of Indian Affairs
911 NE 11th Ave.
Portland, Oregon 97232

Re: Reinitiation of the Endangered Species Act Section 7 Formal Programmatic Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Fish Habitat Restoration Activities in Oregon and Washington, CY2007-CY2012.

Dear Mr. Joyner, Mr. Shepard, and Mr. Speaks:

On April 27, 2007, NOAA's National Marine Fisheries Service (NMFS) issued a biological and conference opinion (Opinion) on the effects of the Forest Service, Bureau of Land Management (BLM), and Bureau of Indian Affairs (BIA) (acting for the Coquille Tribe) implementing fish habitat restoration activities in Oregon and Washington. In that Opinion, NMFS concluded that the programmatic action, as proposed, was not likely to jeopardize the continued existence of 18 species of salmon and steelhead listed under the ESA or result in the destruction or adverse modification of designated critical habitat for these species. On September 27, 2007, NMFS confirmed the conference opinion on Puget Sound steelhead as a biological opinion.

On February 11, 2008, NMFS issued a final determination to list the Oregon Coast (OC) coho salmon as threatened, designate critical habitat for this species and issue protective regulations (73 FR 7816). The listing, critical habitat designation, and protective regulations became effective on May 12, 2008. On March 3, 2008, you requested that NMFS reinitiate consultation and issue a new programmatic Opinion on fish habitat restoration activities in Oregon and Washington to include OC coho and their critical habitat. Your request included a supplemental biological assessment analyzing the effects of the proposed restoration actions on OC coho and their habitat. Please find the requested Opinion attached.

The NMFS listed the southern distinct population segment (DPS) of green sturgeon as threatened under the ESA on April 7, 2006 (71 FR 17757). New information indicates that Southern DPS green sturgeon use estuarine and lower river portions of the action area as habitat for growth and development to adulthood and for adult feeding. The NMFS has not designated critical habitat for southern DPS green sturgeon, or issued protective regulations under section 4(d) of the ESA. Although your submitted biological assessment did not include a determination of effect for southern DPS green sturgeon, NMFS has enough information to determine that the proposed fish habitat restoration activities are not likely to adversely affect this species.

This document also includes the results of our analysis of the action's likely effects on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes one conservation recommendation to avoid, minimize, or otherwise offset potential adverse effects on EFH. Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations.

If the response is inconsistent with the EFH conservation recommendation, the Forest Service, BLM, or BIA must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, we ask that you clearly identify the number of conservation recommendations accepted.

If you have questions regarding this consultation, please contact Spencer Hovekamp, Branch Chief of the Eastern Oregon Habitat Branch of the Oregon State Habitat Office, at 541.975.1835, ext. 224.

Sincerely,

Michael Dehar

for D. Robert Lohn
Regional Administrator

cc: Rollie White, USFWS
Scott Peets, FS
Al Doelker, BLM
Jason Robinson, Coquille Tribe

Endangered Species Act – Section 7 Programmatic Consultation
Biological Opinion

and

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

Fish Habitat Restoration Activities in Oregon and Washington, CY2007-CY2012

Lead Action Agencies:	USDA Forest Service USDI Bureau of Land Management USDI Bureau of Indian Affairs
Consultation Conducted By:	National Marine Fisheries Service Northwest Region
Date Issued:	June 27, 2008
Issued by:	for D. Robert Lohn Regional Administrator
NMFS Nos.:	**FS: 2008/03505** **BLM: 2008/03506** **BIA: 2008/03507**

TABLE OF CONTENTS

INTRODUCTION 1
Background and Consultation History 1
Proposed Action 2
Geographic Scope 2
Implementation Process 3
Description of the Proposed Activity Categories 5
General Practices and Requirements for Each Activity Category 34
Action Area 37

ENDANGERED SPECIES ACT 38
Biological Opinion 38
Status of the Species and Critical Habitat 38
Environmental Baseline 75
Effects of the Action 78
Effects on Listed Species 108
Effects on Critical Habitat 110
Cumulative Effects 113
Conclusion 114
Conservation Recommendations 116
Reinitiation of Consultation 116
Incidental Take Statement 116
Amount or Extent of Take 117
Reasonable and Prudent Measures 119
Terms and Conditions 120

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT 122
Essential Fish Habitat Conservation Recommendations 123
Statutory Response Requirement 124
Supplemental Consultation 124

DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW 125

LITERATURE CITED 127

Appendix 1. Analysis of Small Stream Herbicide Exposure and Salmonid Risk Potential 144

INTRODUCTION

This document contains a programmatic biological opinion (Opinion) and incidental take statement issued to the Forest Service, Bureau of Land Management (BLM), and Bureau of Indian Affairs (BIA) for Fish Habitat Restoration Activities in Oregon and Washington, CY2007-CY2012. This document was prepared 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 National Marine Fisheries Service (NMFS) also completed an essential fish habitat (EFH) consultation, 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 docket for this consultation is on file at the Oregon State Habitat Office, in Portland, Oregon.

Background and Consultation History

On April 27, 2007, NOAA's National Marine Fisheries Service (NMFS) issued an Opinion and EFH consultation on the effects of the Forest Service, BLM, and BIA (acting for the Coquille Tribe) (collectively referred to as the Action Agencies hereafter) implementing fish habitat restoration activities in Oregon and Washington. In this Opinion, NMFS concluded that the programmatic action, as proposed, was not likely to jeopardize the continued existence of 16 species of salmon and steelhead listed under the ESA or result in the destruction or adverse modification of designated critical habitat for these species. The Opinion was based on information provided in the Action Agencies' biological assessment (BA) and developed during formal consultation. On September 27, 2007, NMFS confirmed the conference opinion on Puget Sound steelhead (*Oncorhynchus mykiss*) as a biological opinion.

On February 11, 2008, NMFS issued a final determination to list the Oregon Coast (OC) coho salmon (*O. kisutch*) as threatened, designate critical habitat for this species and issue protective regulations (73 FR 7816). The listing, critical habitat designation, and protective regulations became effective on May 12, 2008. On March 3, 2008, the action agencies requested that NMFS reinitiate our programmatic Opinion on fish habitat restoration activities in Oregon and Washington to include OC coho salmon and their critical habitat. Formal consultation was reinitiated on this date. The Action Agencies' request included a supplemental biological assessment analyzing the effects of the proposed restoration actions on OC coho salmon and their habitat. This Opinion, which includes OC coho salmon and their critical habitat, will supplant the previous Opinion and incidental take statement. This Opinion will serve as our determination that the proposed fish habitat restoration activities are not likely to adversely affect southern distinct population segment (DPS) of green sturgeon (*Acipenser medirostris*). Information about this species and the expected effects of the proposed action is included in the status of the species, environmental baseline, and effects of the action sections of this Opinion.

Proposed Action

For purposes of this consultation, the proposed action is to implement 19 categories of restoration actions on FS and BLM lands in Oregon and Washington and the Coquille Indian Reservation in Oregon. The Action Agencies propose to begin implementing projects under this consultation in calendar year (CY) 2007 and stop implementing new projects under this consultation after CY2012.

Geographic Scope

This programmatic consultation covers those portions of Forest Service (FS) and BLM administrative units found in Oregon and Washington and the Coquille Reservation located in Western Oregon. It also covers portions of FS and BLM administrative units that are primarily located in Oregon and Washington, but overlap into California (Rogue/Siskiyou National Forest), Nevada (Lakeview and Vale BLM District) and Idaho (Wallowa-Whitman National Forest). Table 1 lists the National Forests and BLM Districts covered by this programmatic consultation.

Table 1. National Forests and BLM Districts, with state location, covered by this consultation.

Land Management Unit	State
National Forests	
Deschutes	OR
Fremont/Winema	OR
Malheur	OR
Mt. Hood	OR
Ochoco	OR
Rogue River/Siskiyou	OR/CA
Siuslaw	OR
Umpqua	OR
Wallowa/Whitman	OR/ID
Willamette	OR
Colville	WA
Gifford Pinchot	WA
Mt. Baker/Snoqualmie	WA
Okanogan/Wenatchee	WA
Olympic	WA
Columbia River Gorge Scenic Area	OR/WA
Umatilla	OR/WA
BLM Districts	
Burns	OR
Coos Bay	OR
Eugene	OR
Lakeview	OR/NV
Medford	OR
Prineville	OR
Roseburg	OR
Salem	OR
Vale	OR/NV
Spokane	WA

This consultation also covers actions that occur on non-Federal lands when that action is located immediately adjacent to a FS or BLM unit and the project helps achieve FS and/or BLM aquatic restoration goals as covered under Wyden Amendment authority (16 U.S.C. 1011(a), as amended by Section 136 of PL 105-277). To be included, such non-Federal land projects must follow all elements of the proposed action described in this Opinion. The Action Agencies will ensure that actions covered under this programmatic on non-Federal land undergo the same process and compliance as projects occurring on action agency land. The Action Agencies shall retain discretion over the private land action in order to ameliorate any unexpected adverse effects during and after project implementation.

Implementation Process

The Action Agencies propose the four step implementation process described below to carry out and monitor projects under this programmatic Opinion. This process takes advantage of the interagency Level 1 Teams[1] described in *Streamlining Consultation Procedures Under Section 7 of the Endangered Species Act* (USDA Forest Service, NMFS, Bureau of Land Management, and U.S. Fish and Wildlife Service 1999).

1. **Integration of Project Design Criteria (PDC), Conservation Measures, and Terms and Conditions into Project Design and Contract Language**. The Action Agency project lead will integrate species and activity category-appropriate design criteria and conservation measures into the proposed restoration action. The Action Agencies propose appropriate design criteria and conservation measures in the BA and they will be incorporated into contract language or force-account work plans.

2. **Project Notification and Reporting.** The Level 1 Team for areas where projects are implemented will meet at least annually to discuss implementation of this programmatic consultation. Level 1 Teams will discuss both advance project notification and completed projects. The date of the meeting will be determined by the individual Level I Teams. This notification and reporting process may be adapted to adhere to the local Level 1 Team meeting schedules, operating protocols, and forms. Because the proposed activities have already proceeded through formal consultation, additional approval from NMFS Level 1 Team members is not necessary. However, the action agencies recognize that NMFS Level 1 Team members can offer additional site specific information that may aid project planners.
    a. **Project Notification Meeting**. Level 1 Teams will discuss aquatic restoration projects planned for implementation during the upcoming work season. NMFS biologists may provide additional information that will assist in project design (*e.g.* early spawning timing anticipated due to an ongoing drought). A Project Notification Form shall be provided to the Level 1 Team members prior to the meeting and should include the following information:

[1] Level 1 Teams consist of at least one biologist from the each of the following agencies: Forest Service, BLM, US Fish and Wildlife Service, and NMFS. These teams cooperatively conduct ESA section 7 consultations in a defined geography, usually a National Forest and adjacent BLM District.

i. Location – 6th field HUC[2]- 12 digit code and name.
ii. Timing – Project start and dates.
iii. Activity Type – Identify all proposed activity types that apply.
iv. Project Description – Brief narrative of the project and objectives.
v. Extent – Number of stream miles or acres to be treated.
vi. Species Affected – Listed fish and or wildlife species, critical habitat, and or EFH affected by the project.

b. **Completed Projects**. The Action Agencies will report to the Level I Team on all high impact and low impact projects implemented the previous year. This includes Wyden Amendment projects. The reports will include the following information necessary for NMFS tracking needs:
i. Location – 6th field HUC and name.
ii. Timing – Project start and end dates.
iii. Activity Type – All that apply from Table 6 of the BA.
iv. Project Description – Brief narrative of the project and objectives.
v. Extent – Number of stream miles or acres treated.
vi. Species affected – fish and or wildlife species affected by the project, critical habitat and/or EFH.
vii. Fish Handling – If fish are handled during rescue operations the project biologist will describe removal methods, stream conditions, and the number of fish affected. This report will likely be limited to culvert replacement projects.
viii. Any authorized incidental take.
ix. Agency Name – Agency and project lead name.
x. Date of submittal.

3. **Monitoring Requirements.** Monitoring will be conducted during project implementation and after project completion.

a. **Monitoring during Project Implementation and Follow-up Remedial Activities if Necessary**
i. Monitor during project implementation to ensure effects are not greater (amount, extent) than anticipated and contact Level 1 representatives if problems arise.
ii. Fix any problems that arise during project implementation.
iii. Regular biologist coordination with contract officer if biologist is not always on site to ensure contractor is following all stipulations.

b. **Post-project assessment.** A post-project review shall be conducted after winter high flows and rains. This can consist of a simple walk-through assessment to answer the following questions:
i. Are there post-project effects that were not considered during consultation?
ii. Is there head-cutting, degradation of embedded substrate, or a scour pool at the outlet of culverts that may indicate that project goals have not been met?

[2] Hydrologic Unit Code (HUC), information for specific HUCs can be found at: http://nppc.bpa.gov/

iii. In cases where remedial action is required, such actions are permitted without additional consultation if they use design criteria and conservation measures and the effects of programmatic actions covered are not exceeded.

4. **Level 1 Team Field Review**. At its discretion, the Level 1 Team shall conduct field reviews to determine whether a project meets the requirements of this programmatic consultation.

Description of the Proposed Activity Categories

The Action Agencies propose restoration activities designed to maintain, enhance and restore watershed functions that affect aquatic species. This consultation addressed those aquatic restoration activities that are commonly implemented on Action Agency lands that are predictable as to their effects to ESA-listed species and EFH and are consistent with broad scale aquatic conservation strategies. This Opinion addresses the following 19 aquatic restoration program activity types:

1. Large Wood, Boulder, and Gravel Placement
2. Reconnection of Existing Side Channels and Alcoves
3. Head-cut Stabilization and Associated Fish Passage
4. Bank Restoration
5. Fish Passage Culvert and Bridge Projects
6. Irrigation Screen Installation and Replacement
7. In-channel Nutrient Enhancement
8. Floodplain Overburden Removal
9. Reduction of Recreation Impacts
10. Estuary Restoration
11. Riparian Vegetation Treatment (non-commercial, mechanical)
12. Riparian and Upland Juniper Treatment (non-commercial)
13. Riparian Vegetation Treatment (controlled burning)
14. Riparian Area Invasive Plant Treatment
15. Riparian Exclusion Fencing (with water gaps and stream crossings)
16. Riparian Vegetation Plantings
17. Road Treatments
18. Removal of Legacy Structures
19. Fisheries, Hydrology, Geomorphology Wildlife, Botany, and Cultural Surveys in Support of Aquatic Restoration

To aid in the analysis of effects for this consultation, the Action Agencies divided the proposed activity types into Group 1 and Group 2. The Group 1 projects are proposed to occur within the bankfull stream channel and will result in one of the following: Project related turbidity and mobilization of fine sediment; possible herbicides for certain invasive plant treatments; in the stream during the low flow period; short-term riparian disturbance; or harassment of ESA-listed fish. The Group 2 projects are proposed outside of the bankfull channel and will result in small amounts of turbidity and mobilized fine sediment (and herbicides for certain invasive plant

treatments) in the stream during the low flow period; minor, short-term disturbance of riparian areas; or harassment of ESA-listed fish. Although the Group 2 projects do not involve in-channel construction, these actions will still result in some adverse effects to listed species or EFH.

To limit short-term adverse effects occurring in any one area, the action agencies propose that no more than 10 Group 1 aquatic restoration projects will be implemented under this programmatic consultation within a single 5th field watershed each year. This threshold was selected to ensure that short-term adverse effects associated with beneficial actions would not collectively compromise watershed function or integrity. The ten Group 1 projects that can be conducted within a 5th field watershed may consist of the same activity type or a mixture of the Group 1 activity types. The Action Agencies propose no limit on the number and extent of the Group 2 projects that can be conducted within a 5th field watershed. Tables 2 and 3 list the Group 1 and Group 2 activity types and the metrics used to identify the extent of one project.

Table 2. Group 1 Aquatic Restoration Activity Categories and Metrics Used to Identify the Extent of One Project.

Activity Type	Metrics Used to Identify the Extent of One Project
Large Wood, Boulder, and Gravel Placement	One project is equal to: 15 stream miles of helicopter placement or 5 miles using cable yarding equipment or 1 stream mile of placement with excavator-type equipment.
Reconnection of Existing Side Channels and Alcoves	One project is equal to 1 side channel/alcove project
Head-cut Stabilization and Associated Fish Passage	One project is equal to 1 head-cut project and associated fish passage structures.
Bank Restoration	One project is equal to stabilization of eroding banks along less than 0.5 mile of stream.
Fish Passage Culvert and Bridge Projects	One project is equal to removal or replacement of 1 road crossing structure.
Irrigation Screen Installation and Replacement (Weir Removal)	One project is equal to removal of 1 in-channel weir structure.
Road Decommissioning	One project is equal to 1 mile of road decommissioning where the road-bed is altered with heavy equipment and the road bed encroaches into the bankfull channel.
Floodplain Overburden Removal	One project is equal to overburden removal along 1 mile of stream. Includes floodplains on both sides of stream.
Riparian Area Invasive Plant Treatment (includes area within bankfull width channel only)	Within each sixth field HUC containing listed aquatic species, no more than 10% of the total riparian area, measured as adjacent stream length, will be treated within any one year period.
Removal of Legacy Structures	One project is equal to 1 stream mile of legacy structure removal.

Table 3. Low Impact Aquatic Restoration Activity Categories and Metrics Used to Identify the Extent of One Project.

Activity Type	Metrics Used to Identify the Extent of One Project
Irrigation Screen Installation and Replacement	No limit on number of screens
In-Channel Nutrient Placement	No limit on number of miles treated
Estuary Restoration	No limit on number of acres treated
Riparian Vegetation Treatment (non-commercial, mechanical)	No limit on number of acres treated
Riparian and Upland Juniper Treatment (non-commercial)	No limit on number of acres treated
Riparian Vegetation Treatment (controlled burning)	No limit on number of acres treated
Riparian Area Invasive Plant Treatment (outside of bankfull channel)	Within each 6th field HUC containing listed aquatic species, no more than 10% of the total riparian area will be treated within any one year period.
Riparian Exclusion Fencing	No limit on riparian acres or stream miles
Road Treatments	No limit on road miles treated for roads outside of bankfull channel.
Reduction of Recreation Impacts	No limit on acres or miles treated.
Survey and Monitoring	No limit on acres or miles surveyed

Consistent application of the following project descriptions, design criteria, and conservation measures for each category of restoration action is essential to programmatic consultation. Doing so ensures that the analysis conducted during consultation is based on the actual manner in which the programmatic activities will be carried out for the duration of the program, thereby ensuring that NMFS's effects analysis is accurate, that the amount or extent of take anticipated is reliable, and that determinations regarding jeopardy and adverse modification are properly framed and valid.

1. Large Wood, Boulder, and Gravel Placement and Tree Removal for Large Wood Projects

Description

Under this category, the Action Agencies propose to place large wood (LW) and boulders in stream channels and adjacent floodplains to increase channel stability, rearing habitat, pool formation, spawning gravel deposition, channel complexity, hiding cover, low velocity areas, and floodplain function. In areas where natural gravel supplies are low (immediately below reservoirs, for instance), gravel placement may be used to improve spawning habitat. Full channel-spanning porous boulder weirs (boulder weirs) will only be installed in streams with a legacy of splash damming, stream cleaning, or other activities that have resulted in highly uniform, incised, bedrock-dominated channels with few boulders or woody debris. Live and dead trees may be removed from riparian areas to provide LW for restoration projects, under special conditions described below. LW, boulder, boulder weirs and gravel projects will involve the use of log trucks and dump trucks for transport and excavator-type machinery, spyders, cable yarders, draft horses, or helicopters for placement.

Design Criteria

1. Place LW and boulders only in those areas where they would naturally occur and in patterns that closely mimic that which would naturally occur for that particular stream type.
2. LW includes whole conifer and hardwood trees, logs, and root wads. LW size (diameter and length) should account for bankfull width and stream discharge rates. When available, trees with rootwads should be a minimum of 1.5 x bankfull channel width, while logs without rootwads should be a minimum of 2.0 x bankfull width. Place wood in a manner that most closely mimics natural accumulations of LW for that particular stream type. Structures may partially or completely span stream channels or be positioned along streambanks.
3. No conifers should be felled in the riparian area for in-channel large wood placement unless conifers are fully stocked and are consistent with project design criteria in vegetation treatment categories. Felled hazard trees can be used for in-channel wood placement.
4. Key boulders (footings) or LW may be buried into the streambank or channel but shall not constitute the dominant placement method of boulders and LW.
5. Anchoring Large Wood – Anchoring large wood with cable should only occur after first reviewing feasibility of the following, in preferential order, avoid cabling except as a last resort:
    a. The size and weight of the wood sufficient for stability, no anchoring is required.
    b. The wood is oriented in such a way that movement is unlikely (sharp bends in the stream, naturally narrow reaches, placed within a functional riparian zone.
    c. Ballasting (gravel and/or rock) is used to increase the mass of the structure to resist movement (the height of the structure generally must be above design flow elevations) (this works well in systems with intact floodplains).
    d. Large boulders are used as anchor points for the large wood.
    e. Wood is pinned with rebar to large rock to increase its weight (the wood/rock combinations are still independent in the overall structure).
6. Gravel Augmentation – Gravel augmentation should only occur in areas where the natural supply has been eliminated or significantly reduced through anthropogenic means. Gravel to be placed in streams shall be a properly sized gradation for that stream, clean, and non-angular. When possible use gravel of the same lithology as found in the watershed. After gravel placement, allow the stream to naturally sort and distribute the material.
7. Boulder Weirs:
    a. Full channel-spanning boulder weirs are to be installed only in highly uniform, incised, bedrock-dominated channels to enhance or provide fish habitat in stream reaches where log placements are not practicable due to channel conditions (not feasible to place logs of sufficient length, bedrock dominated channels, deeply incised channels, artificially constrained reaches, *etc.*), where damage to infrastructure on public or private lands is of concern, or where private landowners will not allow log placements due to concerns about damage to their streambanks or property.
    b. Install boulder weirs low in relation to channel dimensions so that they are completely overtopped during channel-forming flow events (approximately a 1.5-year flow event).
    c. Place boulder weirs diagonally across the channel or in more traditional upstream pointing "V" or “U” configurations with the apex oriented upstream. Structures installed perpendicular to the streamflow are not covered in this consultation.

d. Boulder weirs are to be constructed to allow upstream and downstream passage of all native listed fish species and life stages that occur in the stream. This can be accomplished by providing plunges no greater than 6" in height, allowing for juvenile fish passage at all flows.
e. The use of gabions, cable or other means to prevent the movement of individual boulders in a boulder weir is not allowed.
f. Rock for boulder weirs shall be durable and of suitable quality to ensure permanence in the climate in which it is to be used. Rock sizing depends on the size of the stream, maximum depth of flow, planform, entrenchment, and ice and debris loading
g. The project designer or an inspector experienced in these structures should be present during installation.
h. Full spanning boulder weir placement should be coupled with measures to improve habitat complexity and protection of riparian areas to provide long-term inputs of LW.

8. Tree Removal for LW Projects
    a. Trees may be removed by cable, groundbased equipment, horses or helicopters, or felled directly into the stream. Felled trees may be stock-piled for later use in instream restoration projects.
    b. Individual trees or small groups of trees (<5) should come from the periphery of permanent openings (roads etc) or from the periphery of non-permanent openings (*e.g.* plantations, along recent clear-cuts etc).
    c. Single trees may only be removed from the first two lines of trees.
    d. Trees selected for LW restoration projects must be spaced at least one site potential tree height apart and at least one crown width from any trees with potential nesting structure for ESA-listed bird species.
9. If other aquatic restoration activities included in this consultation are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures
No additional conservation measures are proposed for this activity category.

Excluded Activities
The following activities are not covered by this consultation: In non-bedrock dominated systems, boulder weirs greater than ½ the channel width; restoration projects that include individual structures longer than 7 bankfull channel widths.

2. Reconnection of Existing Side Channels and Alcoves

Description
The Action Agencies propose to reconnect or restore existing side channels and alcoves to increase rearing habitat for juvenile fish and high flow refuge areas for all life stages of fish. Functioning side channels have inlet and outlet connections to the main channel and often flow only during bankfull or greater flood events. Functioning alcoves are back-water channels that typically contain water during both low and high flows. This proposed activity category includes the removal of plugs which block water movement through side channels and alcoves. Further, side channel and alcove improvements including fill removal within channels and alcoves, large wood and/or boulder placement, riparian planting are proposed. Boulder

placement may be used in the main river to stabilize the channel and bring the entrance of the side channel into alignment (vertically and horizontally). Construction would involve use of heavy equipment, such as excavators, spyders, backhoes, and dump trucks.

Design Criteria

1. Excavated material removed from side-channels or alcoves shall be hauled to an upland site or spread across the adjacent floodplain in a manner that does not restrict floodplain capacity.
2. Design and construct side-channels in such a manner as to prevent the capture and complete relocation of the main channel.
3. Design project to naturally maintain inlet and outlet connections with the main stream channel (*i.e.* placement of LW to increase local scour).
4. Should fish rescue occur, use fish handling criteria listed under activity #5.
5. If other aquatic restoration activities are included as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures

No additional conservation measures are proposed for this activity category.

Excluded Activities

Creation of new side channels and excavation of severely aggraded (completely filled in) side channels and alcoves are not covered by this consultation.

3. Head-cut Stabilization and Associated Fish Passage

Description

The Action Agencies propose to stabilize active or potentially active head-cuts to prevent further channel degradation (upstream migration of head-cut) and promote downstream aggradations. In streams currently or historically occupied by fish, fish passage will be provided over the stabilized head-cut through a series of rock/boulder or log step-pool structures, to be in compliance with relevant fish passage criteria for jump height, and pool depth, among other things.

During emergency head-cut stabilization events, (high flow events, where no prior knowledge of head-cut exists and stabilization action must immediately occur), short-term head-cut stabilization may occur without associated fish passage measures. However, fish passage must be incorporated into the final head cut stabilization action, to be completed during the first subsequent in-water work period. This subsequent action may include complete or partial removal of all materials placed at the head-cut during emergency stabilization efforts, and replacement with carefully designed, long-term, fish passage friendly, head-cut stabilization options (see below for options). Construction may involve use of heavy equipment, such as excavators, spyders, backhoes, dump trucks.

Design Criteria

1. In an emergency head-cut event, armor the head-cut with sufficient appropriately sized material to prevent continued up-stream movement. Materials can include both rock and organic materials which are native to the area. The Action Agencies will focus stabilization efforts in the plunge pool, the head cut, and a short distance above the head-cut. Minimize

lateral migration of channel around the head cut ("flanking") by placing rocks and organic material at a lower elevation in the center of the channel cross section to direct flows to the middle of channel.

2. For non-emergency head cut stabilization actions, the following two grade control treatments are acceptable alternatives to stabilize a head cut and re-establish fish passage. These alternatives are also acceptable to complete channel stabilization and fish passage activities during the first in-water work period, for previously-treated emergency head-cut sites. These alternatives may also include complete or partial removal of all materials placed at head-cut during emergency stabilization efforts, and replacement with carefully designed, long-term, fish passage friendly, head-cut stabilization options. The choice of treatment should be based on site characteristics and limitations (*i.e.,* channel slope, bed material type), but may also be based on material availability, economics, land use, design competence or familiarity, and/or regulatory restrictions (*i.e.,* jump heights for fish). NMFS Level 1 Team members will assist the action agencies in choosing an appropriate treatment.
    a. Large Roughness Elements: In many Pacific Northwest streams, large wood and boulders provide natural grade control in the form of channel spanning log jams or debris flow deposits. Hence, the designed rock and wood structure should mimic natural colluvial features, such as debris flow or landslide deposits, that provide this base level control or grade stabilization in areas where the risk of head-cut migration exists. This technique is applicable to a wide range of stream types, from low gradient meandering streams (less than 1%) to high gradient cascade channels (greater than 8%). The goal of using large roughness elements is not to completely halt the incision process, but rather to slow it down and spread the elevation change over a greater length of channel. Since log jams are porous structures, not all of the sediment will be held in place; however, sediment inputs will be spread out over time rather than introduced to the stream as one large pulse. A log jam is also self-maintaining as long as more large wood is available in the stream system. Rock and wood should be sized so that it is not mobile during the design flood. Buoyancy calculations to determine appropriate ballast requirements should be completed for structures that will be completely inundated.
    b. Rock and Log Weirs: Rock and log weirs are very low channel spanning structures that are often used to stabilize streambeds and halt channel incision. These weirs are used in low gradient (generally less than 2%) streams. The weirs are 'V' shaped, oriented with the apex upstream, and are lower in the center to direct flows to the middle of channel. A series of V weirs will help to stabilize stream gradient, dissipate energy, provide some level of bank protection, and will maintain fish passage. Weirs should be keyed into the stream bed by a minimum of 2.5 x their exposure height to minimize structure undermining due to scour. The weir should also be keyed into both banks a minimum of 8 feet. If several structures will be used in series, weir spacing should be no closer than the net drop divided by the channel slope (for example, a one-foot-high weir in a stream with a 2% gradient will have a minimum spacing of 50 feet. Weirs can fail if flow goes subsurface flow below weir material. If placed material is coarse and unconsolidated, it is possible that upstream flows will go subsurface and reemerge at the downstream end of the structure, effectively causing a complete passage barrier. Careful consideration of subsurface flow is therefore required before weir construction. The inclusion of fine material in the

sediment mix and construction techniques that include washing material into place to seal the weir to the channel bed is highly recommended.

3. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures
No additional conservation measures are proposed for this activity category.

Excluded Activities
The proposed action for this programmatic consultation does not include any structure that uses gabion baskets, sheet pile, concrete, articulated concrete block or cable anchors. Straight weirs, which disperse flows and can cause channel widening and thus structure "flanking" (erosion around the ends of the structure), are also not included.

4. Bank Restoration

Description
The Action Agencies propose to restore eroding streambanks to reduce chronic bank erosion, improve water quality, restore natural channel cross-section, allow for natural channel adjustments, expand floodplain area, promote growth of riparian vegetation, and where appropriate (*e.g.,* outside meander bends) create undercut banks for adult and juvenile fish hiding cover. Projects will not significantly restrict the channel migration zone or ability of the channel to form and maintain habitat. Construction will involve use of heavy equipment, such as excavators, spyders, backhoes, dump trucks.

Design Criteria
1. Bank restoration work will focus on eroding streambanks, primarily the outside edge of meander bends.
2. Limit bank restoration projects to those sites where existing channel conditions are at or near reference channel conditions—width:depth ratio, radius of curvature, etc. To the extent possible, use bank stabilizing materials that would naturally occur at that site (such as LW, woody and herbaceous plantings, native sedge and rush mats, or native rock).
3. Banks may be reshaped and slopes graded where the objective is to reduce blank slope angle without changing the location of the bank toe and to provide more favorable planting surfaces.
4. Jute matting or other biodegradable material can be used in conjunction with plantings to help prevent erosion of affected banks.
5. If other aquatic restoration activities included in this BA are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures
No additional conservation measures are proposed for this activity category.

Excluded Activities
Use of dikes, groins, buried groins, drop structures, porous weirs, weirs, riprap, rock toes, and similar structures to stabilize streambanks are not covered by this Opinion.

5. Fish Passage Culvert and Bridge Projects

Description

The Action Agencies propose to remove or replace existing road-stream crossing structures (culverts and bridges) that restrict fish passage and natural flows with stream simulation structures to restore up- and downstream fish passage for all life stages of native fish. Replacements of existing road-stream crossing structures that do not restrict fish passage are permissible. Construction would involve use of heavy equipment, such as excavators, cranes, backhoes, front-end loaders, dump trucks, bull dozers, and on occasion pile-drivers and helicopters.

Design Criteria

1. Fish passage projects will be designed by an experienced engineer with design input from an experienced fish biologist and hydrologist. Such personnel shall oversee or review the project during construction to ensure that project designs and conservation measures are being properly implemented.
2. Forest Service Design Assistance Teams or the BLM and Coquille Tribe equivalent will provide design review for projects that exceed $100,000 or will result in structures that are greater than 20 feet wide.
3. Assess sites for a potential to head-cut below the natural stream gradient. Projects that lead to head-cutting below the natural stream gradient are excluded from this consultation.
4. Design Standards
    a. Structure Type – Structure types include closed-bottomed culverts, open-bottomed arch culverts, and bridges. Structure material must be concrete or metal.
    b. Structure Width – The structure width shall never be less than the bankfull channel width. (The stream width inside the culvert or between bridge footings shall be equal to or greater than the bankfull width.) The minimum structure width and height for a closed bottom culvert shall be 6 feet to allow manual placement of stream simulation material. Structures must accommodate a 100-year flood flow while maintaining sediment continuity (similar particle size distribution) within the culvert as compared to the upstream and downstream reaches. To meet this requirement, unconfined channel types (Rosgen C, E, and B channel types (Rosgen 1996)) may require structures wider than bankfull and/or the addition of flood relief culverts or other comparable flood relief methods.
    c. When possible, flood relief culverts will be designed to restore and maintain access to off-channel rearing and high flow areas for juvenile and adult fish. Therefore, existing floodplain channels should be the first priority for location of flood relief culverts which should be installed in a manner that matches floodplain gradient and does not lead to scour at the outlet.
    d. Channel Slope – The structure slope shall approximate the average channel gradient of the natural stream up- and downstream of the structure. The maximum slope for closed-bottomed culverts shall not exceed 6% because of difficulties in retaining substrate in the culvert at higher gradients. Open-bottom arches can be placed in channel gradients that exceed 6%.
    e. Embedded Culvert – If a closed culvert is used, the bottom of the culvert shall be buried into the streambed not less than 20% and not more than 50% of the culvert height. For open-bottomed arches and bridges, the footings or foundation shall be

designed to be stable at the largest anticipated scour depth. Substrate and habitat patterns within the culvert should mimic stream patterns that naturally occur above and below the culvert. Coarser material may be incorporated to create velocity breaks during high flows, thereby improving fish passage, and to provide substrate stability.

f. Riprap – The use of riprap is permissible above bankfull height to protect the inlet or outlet of new culverts or open-bottomed arches. If the use of riprap is required for culvert stability, then an additional analysis may be required to ensure that the structure is not undersized. Riprap may only be placed below bankfull height when necessary for protection of abutments and pilings for bridges. However, the amount and placement of riprap around the abutments and/or pilings should not constrict the bankfull flow.
g. Grade Control Structures – Grade control structures are permitted to prevent head-cutting above or below the culvert or bridge. Grade control typically consists of boulder structures that are keyed into the banks, span the channel, and are buried in the substrate.
h. Where applicable, incorporate road dips into crossing designs, to ensure catastrophic flood events will transport overflow back into the downstream channel instead of the road bed.
i. Structures containing concrete must be sufficiently cured or dried before they come into contact with stream flow.
j. In cases of structure removal or when removing an existing structure and replacing it with a bridge, consideration should be given to restoring the stream channel and reconnecting the floodplain at the site.
k. When removing woody debris from the road-crossing inlet, place the debris downstream of the road crossing.
l. Monitor structures after high flow events, which occur during the first fall/winter/spring after project completion. Assess the following parameters: head-cutting below natural stream gradient, substrate embeddedness in the culvert, scour at the culvert outlet, and erosion from sites associated with project construction. Apply remedial actions (using project design criteria and conservation measures) if projects do not meet the intended goals.
m. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

<u>Conservation Measures</u>

Along with the general conservation measures summarized at the end of this section, the following conservation measures will be used to minimize sediment and turbidity and the effects of fish handling/transport:

1. Isolate construction area and remove fish from project area. Fish shall be removed from project area (see fish capture guidelines below).
2. Dewater Construction Site – Upstream of the isolated construction area, coffer dams (diversions) constructed with non-erosive materials are typically used to divert stream flow with pumps or a by-pass culvert. Diversions constructed with material mined from the streambed or floodplain are not permitted. Pumps must have fish screens and be operated in accordance with NMFS fish screen criteria. Dissipate flow energy at the bypass outflow to

prevent damage to riparian vegetation or stream channel. If diversion allows for downstream fish passage, (*i.e.*, is not screened), place diversion outlet in a location to promote safe reentry of fish into the stream channel, preferably into pool habitat with cover. When necessary, pump seepage water from the dewatered work area to a temporary storage and treatment site or into upland areas and allow water to filter through vegetation prior to reentering the stream channel.

3. Stream Re-Watering – Upon project completion, slowly re-water the construction site to prevent loss of surface water downstream as the construction site streambed absorbs water and to prevent a sudden increase in stream turbidity. Monitor downstream during re-watering to prevent stranding of aquatic organisms below the construction site
4. Fish Handling – If capture, removal, and relocation of fish are required, follow these steps:
    a. All fish capture, removal, and handling activities shall be conducted by an experienced fisheries biologist or technician.
    b. Isolate capture area – Install block nets at upstream and downstream locations and leave in a secured position to preclude fish from entering the project area. Leave nets secured to the stream channel bed and banks until fish capture and transport activities are complete. If block nets or traps remain in place more than one day, monitor the nets and or traps at least on a daily basis to ensure they are secured to the banks and free of organic accumulation and to minimize fish predation in the trap.
    c. Fish Capture Options
        i. Collect fish by hand or dip nets, as the area is slowly dewatered.
        ii. Seining – Use seine with mesh of such a size to ensure capture of the residing ESA-listed fish.
        iii. Minnow traps – Traps will be left in place overnight and in conjunction with seining
        iv. Electrofishing – Prior to dewatering, use electrofishing only where other means of fish capture may not be feasible or effective. The protocol for electrofishing includes the following:
            1. If fish are observed spawning during the in-water work period, electrofishing shall not be conducted in the vicinity of spawning adult fish or active redds.
            2. Only Direct Current (DC) or Pulsed Direct Current (PDC) shall be used.
            3. Conductivity <100 use voltage ranges from 900 to 1100. Conductivity from 100 to 300 then use voltage ranges from 500 to 800. Conductivity greater than 300 then use voltage to 400.
            4. Begin electrofishing with minimum pulse width and recommended voltage and then gradually increase to the point where fish are immobilized and captured. Turn off current once fish are immobilized.
            5. Do not allow fish to come into contact with anode. Do not electrofish an area for an extended period of time. Remove fish immediately from water and handle as described below. Dark bands on the fish indicate injury, suggesting a reduction in voltage and pulse width and longer recovery time.
5. Handling and Release –Fish must be handled with extreme care and kept in water for the maximum extent possible during transfer procedures. A healthy environment for the stressed fish shall be provided—large buckets (five-gallon minimum to prevent overcrowding) and minimal handling of fish. Place larger fish in buckets separate from smaller prey-sized fish. Monitor water temperature in buckets and well-being of captured fish. As rapidly as possible

(especially for temperature-sensitive bull trout), but after fish have recovered, release fish upstream of the isolated reach in a pool or other area that provides cover and flow refuge. Document all fish injuries or mortalities and include in annual report.

Excluded Activities

The proposed action for this programmatic consultation does not include the use of treated wood in replacement bridges. When installing bridges, piers and abutments will not occur in the bankfull width. Replacing culverts using baffles or weirs (hydraulic method) is not covered by this Opinion.

6. Irrigation Screen Installation and Replacement

Description

The Action Agencies propose this activity category for existing water diversions only. Irrigation screen installation and replacement includes installing, replacing, or upgrading off-channel screens to improve fish passage or prevent fish entrapment in irrigation canals. This action also includes the removal of diversion structures that are less than six feet high, or that impound less than 15 acre-feet of water. Construction would involve use of heavy equipment, such as excavators, backhoes, front-end loaders, dump trucks, and bulldozers.

Design Criteria

1. All fish screens must be sized to match the landowner's documented or estimated historic water use or legal water right, whichever is less.
2. Irrigation diversion intake and return points must be designed (to the greatest degree possible) to prevent all native fish life stages from swimming or being entrained into the irrigation system.
3. Screens, including screens installed in temporary and permanent pump intakes, must meet NMFS fish screen criteria.
4. Bypass structures should be big enough to pass kelt steelhead.
5. Abandoned ditches and other similar structures will be plugged or backfilled, as appropriate, to prevent fish from swimming or being entrained into them.
6. When making improvements to pressurized irrigation systems, install a totalizing flow meter capable of measuring rate and duty of water use. For non-pressurized systems, install a staff gage or other measuring device capable of measuring instantaneous rate of water flow.
7. Diversion Removal
    a. Construction Actions – Remove diversion dam and water routing equipment. Heavy machinery operating from the bank or within the channel may be used to aid in removal of diversion structures. Re-watering the construction site occurs at such a rate as to prevent loss of surface water downstream as the construction site streambed absorbs water.
    b. Construction Impacts – Stream channel substrate will be minimally disturbed with the removal of the diversion dam. Restored stream flow will flush out substrate fines within the formerly dewatered area, resulting in increased but short-lived stream turbidity (usually less than 2 hours).
8. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures
For diversion removal, follow the appropriate conservation measures described in Activity #5 above for work area isolation, re-watering, and fish removal.

Excluded Activities
The proposed action for this programmatic consultation does not include the removal of large diversions/structures which have substantial accumulations of sediment that may be released and adversely affect downstream fish, critical habitat and or EFH. Furthermore, consolidation, improvement, and modification of diversions are not covered by this Opinion.

7. In-Channel Nutrient Supplementation

Description
The Action Agencies propose the placement of salmon carcasses, carcass analogs (processed fish cakes), or inorganic fertilizers into stream channels to help return habitat condition (stream nutrient levels) back to historic levels. Large trucks may be used to transport nutrients. Application and distribution of nutrients throughout a stream corridor can occur manually from bridges or streambanks, by boat, or by helicopter.

Design Criteria
1. In Oregon, projects are permitted through Oregon Department of Environmental Quality (ODEQ). The Action Agencies propose use of carcasses from the treated watershed or those that are certified disease free by an Oregon Department of Fish and Wildlife (ODFW) pathologist.
2. In Washington, the Action Agencies will follow Washington Department of Fish and Wildlife's (WDFW) *Protocols and Guidelines for Distributing Salmonid Carcasses, Salmon Carcass Analogs, and Delayed Release Fertilizers to Enhance Stream Productivity in Washington State, 2004*
3. Ensure that the relevant streams have the capacity to capture and store placed carcasses.
4. Carcasses should be of species native to the watershed and placed during the normal migration and spawning times, as would naturally occur in the watershed.
5. Do not supplement nutrients in eutrophic or naturally oligotrophic systems.
6. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures
No additional conservation measures are proposed for this activity category.

Excluded Activities
No excluded activities are proposed for this activity category.

8. Floodplain Overburden Removal

Description
The Action Agencies propose to remove anthropogenic overburden and fill such as dredged mine tailings, railroad beds, dikes, berms, levees, and other fill types from floodplains to restore natural floodplain functions. Such functions include overland flow during high-water events,

dissipation of flood energy, increased water storage to augment low flows, sediment and debris deposition, growth of riparian vegetation, nutrient cycling, and development of side channels and alcoves. Construction would involve use of heavy equipment, such as excavators, earthmovers, scrapers, backhoes, front-end loaders, dump trucks, and bulldozers.

Design Criteria

1. Floodplain characteristics elevation, width, gradient, length, and roughness shall closely mimic those that would naturally occur at that stream and valley type.
2. Overburden or fill comprised of native materials which originated from the project area, may be used to reshape the floodplain, placed in small mounds on the floodplain, used to fill anthropogenic holes, buried on site, or disposed into upland areas.
3. To the greatest degree practicable, non-native fill material originating from outside the project area shall be removed from the floodplain to an upland site.
4. Where it is not possible to remove all portions of dikes and berms, place culverts through or remove portions of such structures to pass high flows, bankfull or greater, into floodplain areas. The width of a breach should be equal to or greater than the bankfull width of the stream. Breaches should be located at a depositional area of the channel. Design for proper number and location of breach sites to help prevent fish stranding as high flows recede.
5. Conduct a contaminant survey for mine tailing removal projects prior to project implantation. If contaminants are found above levels set by the Environmental Protection Agency, a separate consultation is required.
6. Consider decompaction of soils once overburden material is removed.
7. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures

No additional conservation measures are proposed for this activity category.

Excluded Activities

No excluded activities are proposed for this activity category.

9. Reduction of Recreation Impacts

Description

The Action Agencies propose to close or better control recreation use along streams and within riparian areas. This includes removal of designated campgrounds, dispersed camp sites, and foot trails as well as decommissioning of off-road vehicle (ORV) trails in riparian areas. Dispersed and developed campground restoration usually includes some or all of the following: Streambank restoration; placing rock or other barriers such as fences to block vehicle access; gravel surfacing to designate access routes and parking; ripping or sub-soiling sites to remove compaction; planting shrubs and trees to restore streamside, floodplain and meadow vegetation; clearing new sites to provide for displaced use or projected new use and relocating recreation sites outside of riparian areas; reducing or clearing noxious weeds; hardening stream access sites. Construction would involve use of heavy equipment, such as excavators, earthmovers, scrapers, backhoes, front-end loaders, dump trucks, and bulldozers.

Design Criteria

1. Design remedial actions to restore floodplain characteristics. Elevation, width, gradient, length, and roughness shall closely mimic those that would naturally occur in that stream and valley type.
2. Overburden or fill comprised of native materials which originated from the project area may be used to reshape the floodplain, placed in small mounds on the floodplain, used to fill anthropogenic holes, buried on site, and/or disposed into upland areas.
3. To the greatest degree practicable, non-native fill material originating from outside the project area shall be removed from the floodplain to an upland site.
4. Consider decompaction of soils once overburden material is removed.

Conservation Measures

No additional conservation measures are proposed for this activity category.

Excluded Activities

No excluded activities are proposed for this activity category.

10. Estuary Restoration

Description

The Action Agencies propose to restore estuary functions through removal of dikes, berms, levees, culverts and tiles, drainage systems, or portions thereof, including tide gates, which block tidal waters from flooding historic estuaries. Such functions include storage of overland flow during high-tide and flood events, dissipation of flood energy, sediment and debris deposition, growth of riparian vegetation, nutrient cycling, development of side channels and alcoves, and rearing habitat for juvenile salmonids. Construction would involve use of heavy equipment, such as excavators, backhoes, front-end loaders, dump trucks, and bulldozers.

Design Criteria

1. Project implementation shall be conducted in a sequence that will not preclude repairing or restoring estuary functions once dikes/levies are breached and the project area is flooded.
2. An experienced hydrologist, fisheries biologist, botanist, ecologist, and wildlife biologist shall be involved in designing restoration treatments.
3. Culverts and tide gates will be removed using the design criteria and conservation measures, where appropriate, as described in Activity #5 above.
4. Roads within the project area should be removed to allow free flow of water. Material either will be placed in a stable area above the ordinary high water line or highest measured tide or be used to restore topographic variation in wetlands.
5. Some or all concrete, segmented drain tiles placed to drain wetlands should be removed. Fill generated by drain tile removal will be compacted back into the ditch created by removal of the drain tile.
6. Channel construction may be done to recreate channel morphology based on aerial photograph interpretation, literature, topographic surveys, and nearby undisturbed channels. Channel dimensions (width and depth) are based on measurements of similar types of channels and the drainage area. In some instances, channel construction is simply breaching the levee. For these sites, further channel development will occur through natural processes.

7. Ditches constructed and maintained to drain wetlands will be filled. Some points in an open ditch may be over-filled, while other points may be left as low spots to enhance topography and encourage sinuosity of the developing channel.
8. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures
No additional conservation measures are proposed for this activity category.

Excluded Activities
The proposed action for this programmatic consultation does not include replacement of tide gates.

11. Riparian Vegetation Treatment (non-commercial, mechanical)

Description
The Action Agencies propose to conduct non-commercial treatments of vegetation in the riparian area as a means to help restore plant species composition and structure that would occur under natural disturbance regimes. The resulting benefits to the aquatic system can include desired levels of stream shade, bank stability, stream nutrients, large wood inputs, increased grasses, forbs, and shrubs, and reduced soil erosion. An additional benefit is fuels reduction, which decreases the probability of a catastrophic fire in a watershed containing isolated populations of ESA-listed fish. Treatments may include, but are not limited to, the following: Thin conifers in even-age stands (typically plantations) to expedite late-seral conditions; thin conifer under-story to maintain viability of later-seral trees; create stand structure that would be expected under natural disturbance regimes; alder treatments; disease pocket treatments; and create planting gaps to promote growth of conifers, deciduous trees, shrubs, and grass. Brush (felled trees) removal, planting of tree seedlings (conifer and deciduous) and shrubs, and animal damage control (no pesticides) are also included. Equipment may include chainsaws, pruning shears, winch machinery, and slash-busters.

Design Criteria
1. An experienced silviculturist, botanist, ecologist, or associated technician, and wildlife biologist shall be involved in designing vegetation treatments.
2. No roads or landings will be constructed.
3. Thin conifers to accelerate attainment of late-seral conditions. A project example is thinning riparian areas in the ecosystem initiation or competitive exclusion developmental stages within plantations (*i.e.* where even-aged stands are growing because of previous silvicultural prescriptions, wildfire, or disease).
4. Thin dense understories to maintain survival of late-seral trees. A project example is thinning dense understory stands of early- to mid-seral ponderosa pine which have become established as a result of fire exclusion.
5. Restore meadow sites along stream corridors or adjacent uplands through removal of conifers which have become established as a result of fire exclusion or other anthropogenic causes.

6. To increase species diversity of riparian vegetation, fell conifer or hardwood trees (if above natural stocking levels) to create planting gaps.
7. Trees felled within riparian area will be used to restore aquatic and terrestrial habitat by returning large and coarse woody debris levels to within the range of natural variability (RNV). Felled trees in excess of the RNV can be removed or piled and burned. If controlled burns are used, refer to design criteria in activity 13.
8. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures
No additional conservation measures are proposed for this activity category.

Excluded Activities
The use of feller-buncher machinery is not covered in this consultation.

12. Riparian Juniper Treatment

Description
The Action Agencies propose to fell juniper trees occurring in riparian and associated uplands to help restore natural plant species composition and structure that would occur under natural fire regimes. The associated benefits to aquatic and riparian environments include the following: Reduction of soil erosion into stream channels; increased frequencies and diversity of herbaceous, shrub, and tree species; increased bank stability and stream nutrients. Associated uplands include those areas where juniper stands are creating or will create conditions that result in lost ground cover and increased sedimentation into stream channels; upland treatments would only be covered if those treatments directly benefit the aquatic environment. Treatments will emphasize the removal of junipers above natural stocking levels. Equipment may include the use of feller-buncher type equipment, slash-buster, chainsaws, winch machinery, or prescribed fire.

Design Criteria
1. Do not cut old-growth juniper, which typically has several of the following features: sparse limbs, dead limbed or spiked tops, deeply furrowed and fibrous bark, branches covered with bright-green arboreal lichens, noticeable decay of cambium layer at base of tree, and limited terminal leader growth in upper branches (Miller *et al*. 2005).
2. On steep or south-facing slopes, where ground vegetation is sparse, leave felled juniper in sufficient quantities to promote reestablishment of vegetation and prevent erosion.
3. If seeding is a part of the action, consider whether seeding would be most appropriate before or after juniper treatment.
4. Where appropriate, move cut juniper stems into the stream channel and floodplain to provide aquatic benefits. Juniper can be felled or placed into the stream to promote channel aggradations as long as such actions do not obstruct fish movement, cover spawning gravels of ESA-listed fish or increase width to depth ratios.
5. When using feller-buncher and slash-buster equipment, operate equipment in a manner that minimizes soil compaction and disturbance to soils and desired native vegetation to the

greatest degree possible. Equipment exclusion areas (buffer area along stream channels) should be as wide as the feller-buncher or slash-buster arm.

6. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures

No additional conservation measures are proposed for this activity category.

Excluded Activities

The placement of juniper in streams where the action will preclude the channel from properly functioning or limiting the ability of stream to reach its natural sinuosity is not covered in this consultation.

13. Riparian Vegetation Treatment (controlled burning)

Description

The Action Agencies propose to implement controlled burning to help restore plant species composition and structure that would occur under natural fire disturbance regimes. Controlled burning of piled, pre-commercially thinned trees associated with mechanical vegetation treatments under this consultation is permissible. Resulting benefits include restoration of desired levels of stream shade, bank stability, soil erosion and stream turbidity, stream nutrients, or large wood inputs. Additional benefits include maintenance of late-seral (old-growth) trees which serve as sources of large wood to streams and a reduced potential of catastrophic fire within watersheds occupied by isolated populations of ESA-listed fish. This treatment should maintain the function of the riparian area as it affects the aquatic environment (*e.g.,* temperature regime). Equipment will include drip torches and chainsaws, along with fire suppression vehicles and equipment.

Design Criteria

1. An experienced fuels technician, silviculturist and fisheries biologist shall be involved in designing prescribed burn treatments.
2. Prescriptions and burn plans should be written to help restore plant species composition and structure within the riparian area that would occur under natural fire regimes.
3. Low severity burns shall constitute the dominant type of controlled burn, resulting in a mosaic pattern of burned and unburned landscape. Low severity burns, as defined in the National Fire Plan (2002), are characterized by the following: Low soil heating, or light ground char, occurs where litter is scorched, charred, or consumed, but the duff is left largely intact, although it can be charred on the surface. Woody debris accumulation is partially consumed or charred. Mineral soil is not changed. Fire severity in forest ecosystems is low if the litter and duff layers are scorched but not altered over the entire depth.
4. Moderate-severity burns are permitted to invigorate decadent aspen stands, willows, and other relevant deciduous species. Such burns shall be contained within the observable historic boundaries of the aspen stand or willow site. Moderate-fire severity, as defined in the National Fire Plan (2002), is characterized by the following: Moderate soil heating, or moderate ground char, occurs where the litter on forest sites is consumed and the duff is deeply charred or consumed, but the underlying mineral soil surface is not visibly altered.

Light colored ash is present. Woody debris is mostly consumed, except for logs, which are deeply charred**.**

5. Non-commercial tree thinning and slash removal maybe required to reduce fuel loads to the level required to implement a low to medium intensity burn.
6. To the greatest degree possible, avoid creating hydrophobic soils when burning hand-piled slash piles within the riparian areas adjacent to the stream. Slash piles should be far enough away from the stream channel so that any sediment resulting from this action will be less likely to reach the stream.
7. Tree thinning may be required prior to project implementation to create fuel loads necessary to carry a controlled fire
8. Ignition can occur anywhere within the riparian area as long as project design criteria are met.
9. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures
No additional conservation measures are proposed for this activity category.

Excluded Activities
This consultation does not cover burning mechanical-built piles slash within the riparian area, fire line construction, or the use of chemical fire retardants.

14. Riparian Area Invasive Plant Treatment

Description
The Action Agencies propose to treat invasive plant infestations in riparian areas using biological controls, mechanical methods, and chemical herbicides. Treatment of an invasive plant site may include one or more of the following treatment methods listed below. A combination of treatments may occur to achieve effective control or eradication of an invasive plant species at many sites. All herbicide applications will comply with label instructions, and may be further restricted as stated below. Treatment methods were selected due to their low potential for adversely affecting aquatic species, while facilitating riparian restoration through invasive plant control. Herbicides were selected due to their low toxicity to aquatic species and application methods were selected for their low potential for contaminating soils, thereby minimizing the risk of herbicides leaching to streams. Methods, tools, and project design criteria are summarized in Table 4, and subsequently discussed in more detail.

Table 4. Summary of methods, tools, and project design criteria for invasive plant treatment

Methods	Tools	Project Design Criteria
Manual & Mechanical Treatment	Various tools listed below	- Minimize work from channel - Minimize ground disturbance - All methods allowed to bankfull of perennial streams, and in intermittent/ephemeral streams - Hand pulling allowed to emergent plants
Hand pulling	Non-motorized tools (weed wrenches, etc)	
Seed clipping	String trimmer or hand-held blade	- Transport only daily fuel supply for chainsaws and string trimmers to project site - Do not fuel chainsaws and string trimmers within 100 feet of water
Stabbing	Shovel, hoe, or similar hand tool	
Girdling	Chainsaw, axe, or similar hand-held tool.	
Cutting	String trimmer or hand-held blade	
Solarization	Plastic, geotextile, cardboard, or similar ground cover material	
Herbicide Treatment	Selective application techniques for chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr (aquatic and non-aquatic labeled), metsulfuron methyl, sethoxydim, sulfometuron methyl Due to fish/aquatic toxicity issues, covering picloram and triclopyr under the restoration programmatic would have been problematic, and would have required design criteria that would have sharply limited their use. Programmatic or project specific coverage for these herbicides can be requested at the Forest (or multi-Forest) level. Imazapic was not included in the restoration programmatic at the request of the FS & BLM because of concerns over non-target plant exposure via root-to-root contact.	- Only daily quantities of herbicide transported to project site - Apply sethoxydim (Poast) when air temperature > 60º F - Do not apply herbicides if rain likely within 24 hours - Emergent treatment restricted to knotweed with aquatic labeled glyphosate - No treatment of submerged aquatic plants - Spill prevention, cleaning, and storage requirements - Use only LI 700, Agri-Dex, or an equivalent when adding surfactants to formulations .
Stem injection	Appropriate syringes/injectors	- Knotweed applicators will be familiar with appropriate methods - Knotweed injection will use only aquatic labeled glyphosate (up to 100% concentration) - Emergent knotweed stems > 0.75 inches will be injected
Cut-stump and Hack & squirt	Backpack or hand-held sprayers, squirt bottles, and wiping applicators (brush, fabric, etc) Axe, hatchet, machete, drill, chainsaw, or other hand-held tool. Squirt bottles, backpack sprayer, or other hand-held spray bottle. Also tree injector and pellet gun.	- Herbicides to be used are imazapyr, metsulfuron methyl, and glyphosate - Application with aquatic glyphosate and aquatic imazapyr allowed to water's edge, and bankfull level for metsulfuron methyl, non-aquatic imazapyr

Methods	Tools	Project Design Criteria
Wicking, wiping	Sponge, wick, or similar absorbent material	- Herbicides to be used are chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr, metsulfuron methyl, sethoxydim, and sulfometuron methyl - Application with aquatic glyphosate and aquatic imazapyr allowed to water's edge and emergent knotweed, and to bankfull level for clopyralid, sethoxydim, and sulfometuron methyl
Spot spray	Backpack, hand-pumped, or hand-held spray bottles	- Herbicides to be used are chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr, sethoxydim, metsulfuron methyl, and sulfometuron methyl - Spray of aquatic glyphosate, metsulfuron, and sulfometuron allowed to bankfull level - Hand-held spray application (no backpack spray) of aquatic glyphosate, imazapyr metsulfuron, and sulfometuron allowed within intermittent or ephemeral channels - Hand-held spray application (no backpack spray) of aquatic glyphosate and aquatic imazapyr to water's edge in perennial channels and to emergent knotweed. - No spray of sethoxydim or clopyralid within 15 feet of perennial stream bankfull level - No spray of chlorsulfuron within 50 feet of perennial stream bankfull level - No spray of sethoxydim, clopyralid, chlorsulfuron in intermittent/ephemeral streams - Drift minimized by 200-800 µm droplet size, and wind speeds consistent with label or local agency requirements, whichever is less
Biological Control	Insects, parasites, or pathogens	- State and U.S. Animal & Plant Health Inspections Service approved - Agents with direct adverse effects to non-target organisms not used
Site Restoration		
Site preparation	Rakes, shovels, hoes, and similar non-motorized hand tools.	- Minimize ground disturbance by clearing only area necessary for effective planting
Planting & seeding	Rakes, shovels, hoes, and similar non-motorized hand tools.	

1. Manual and Mechanical
    a. Hand Pulling – Uprooting is performed either by hand or using hand (non-motorized) tools. Generally appropriate for non-rhizome forming, tap-rooted species or species which produce only from seed. Treatment occurs when plant growth stage and soil conditions allow, and prior to seed-set for annual species. Hand pulling of emergent invasive plants is included.
    b. Seed Clipping – Seed heads are cut, bagged, and removed from the area. The remainder of plant is left intact, but is likely to be treated with another method.
    c. Stabbing – Some invasive plants can be severely weakened or killed by severing or injuring the carbohydrate storage structure at the base of the plant. Depending on species, this structure may be a root corm, storage rhizome, or taproot. Can be accomplished with shovel, hoe, or similar hand tool.
    d. Girdling – A strip of bark is removed around the base of susceptible woody species. The vascular cambium, or inner bark, which translocates carbohydrates between roots and leaves, is removed.

e. Cutting – Removal of the above-ground portion of an invasive plant by cutting with chainsaw, handsaw, pruning shears, or similar hand held device. Also includes mowing or cutting with a string-trimmer type machine, which does not have wheels or contact the ground.
f. Solarization (ground cover) – Invasive plant infestations may be covered with plastic, geotextile, cardboard, or other ground cover material to kill the plant and roots, or reduce plant vigor prior to treatment with another method.

2. Herbicide Treatments
    a. Stem Injection – Stems of actively growing species are injected with herbicide, usually near the base of the plant.
    b. Cut-Stump – Herbicide is applied by spray, squirt, wicking, or wiping to the stump of a plant (usually a shrub or tree) shortly after the shoot or trunk is cut down.
    c. Wicking & Wiping – Use a sponge or wick to wipe herbicide onto foliage, stems, or trunk. Use of wicking and wiping method reduces the possibility affecting non-target plants.
    d. Spot Application – Herbicide is directly sprayed onto target plants only, and spraying of desirable, non-target vegetation is avoided. Includes backpack and hand-pumped spray or squirt bottles, which can target very small plants or parts of plants (foliage, stems, or trunk).
    e. Hack & Squirt – Woody species are cut using a saw or axe, or drilled; herbicide is then immediately applied to the cut with a backpack sprayer, squirt bottle, syringe, or similar equipment.
3. Biological Controls
    a. Biological control is the inoculation of an infestation site with insects, parasites, or pathogens that specifically target the invasive plant species of concern. Treatment of invasive plant infestations with biological controls is a gradual process requiring several years to reach full effectiveness. Subsequent treatment with other methods may also occur.
    b. Site preparation and competitive planting and seeding
        i. Invasive plant infestation sites treated using one or more of the above stated methods may be revegetated by planting cuttings, seedlings, or seeding.
        ii. Site preparation can involve removal of litter and duff layer suitable to allow proper soil to seed/root contact. This will be accomplished by scuffing or scalping micro-sites (generally less than 1 square meter) with hand tools within the larger planting/seeding site.

<u>Design Criteria</u>

1. Manual and Mechanical Methods
    a. Minimize treating invasive plants on streambanks when listed aquatic species are present.
    b. Use the least ground-disturbing method that results in effective invasive plant treatment.
2. Fuel Handling
    a. Transport no more than a one day supply of fuel for chainsaws and string-trimmers into riparian areas.

b. Fueling of chainsaws and string-trimmers will not occur within 100 feet of surface waters.

3. Herbicides General Criteria
    a. Only daily-use quantities of herbicides will be transported to the project site.
    b. Use only LI 700®, Agri-Dex®, or an equivalent when adding surfactants to formulations.
    c. In order to allow efficient volatilization of naptha solvent, apply sethoxydim only during warm (above 60ºF), dry weather.
    d. Do not apply herbicides if precipitation is likely within 24 hours.
    e. Only herbicide application methods for plants emergent from water are stem injection, wicking or wiping, and hand-held spray bottle application of glyphosate to knotweed. No application to submerged aquatic vegetation with any herbicide is included.
    f. Areas used for mixing herbicides will be placed where an accidental spill will not run into surface waters or result in groundwater contamination. Impervious material will be placed beneath mixing areas in such a manner as to contain any spills associated with mixing refilling.
    g. Equipment cleaning and storage and disposal of rinsates and containers will follow all applicable state and Federal laws.
4. Knotweed Stem-injection
    a. Individuals will be familiar with proper glyphosate stem-injection methodology prior to treatment.
    b. Only aquatic glyphosate formulations will be used. The formulation can be used at up to 100% concentration for the stem injection method. The formulation will be diluted to 50% or less active ingredient when applied directly to fresh stem cuts using wicking or wiping, and up to the percentage allowed by label instructions when applied to foliage using low pressure hand-held spot spray applicators.
    c. Larger emergent knotweed can be treated with glyphosate by stem injection, and smaller emergent knotweed by wicking/wiping and spot spray with hand-held sprayers. Wicking or wiping and hand-held spray bottle application of glyphosate allowed to emergent knotweed plants less than 4 to 5 feet tall, and usually smaller.
    d. Emergent plants with stems over 0.75 inch in diameter will be treated by stem injection.
    e. Most knotweed patches are expected to have overland access. However, some sites may only be reached by water travel, either by wading or inflatable raft (or kayak). The following measures will be used to reduce the risk of a spill during water transport:
        i. No more than 2.5 gallons of glyphosate will be transported per person or raft, and typically it will be one gallon or less.
        ii. Glyphosate will be carried in 1 gallon or smaller plastic containers. The containers will be wrapped in plastic bags and then sealed in a dry-bag. If transported by raft, the dry-bag will be secured to the watercraft.
5. Cut-stump and Hack & Squirt
    a. Herbicides to be used are imazapyr, metsulfuron methyl, and aquatic labeled glyphosate.

b. Application with aquatic labeled glyphosate and aquatic labeled imazapyr allowed to waters' edge, and to bankfull level for metsulfuron methyl and imazapyr not labeled for aquatic use.

6. Wicking and Wiping
    a. Herbicides to be used are chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr, metsulfuron methyl, sethoxydim, and sulfometuron methyl.
    b. For perennial streams, wicking and wiping application with aquatic labeled glyphosate and aquatic labeled imazapyr is allowed to waters' edge, and to bankfull level for chlorsulfuron, clopyralid, imazapyr (not aquatic labeled), metsulfuron methyl, sethoxydim, and sulfometuron methyl.
    c. For intermittent and ephemeral channels, chlorsulfuron, clopyralid, aquatic labeled glyphosate, imazapyr, metsulfuron methyl, sethoxydim, and sulfometuron methyl can be applied to all dry portions of the channel.
7. Spot Application
    a. Herbicides to be used are chlorsulfuron, clopyralid, aquatic glyphosate, imazapyr, sethoxydim, metsulfuron methyl, and sulfometuron methyl.
    b. Do not spot spray sethoxydim or clopyralid within 15 feet, and chlorsulfuron within 50 feet, of the bankfull level of perennial streams.
    c. Do not spot spray sethoxydim, clopyralid, or chlorsulfuron within intermittent or ephemeral channels.
    d. Spot spray of aquatic labeled glyphosate and aquatic labeled imazapyr using backpack sprayers allowed to bankfull level on all streams.
    e. Spot spray using aquatic labeled glyphosate and aquatic labeled imazapyr allowed to edge of water with hand-held, hand-pump spray or squirt bottles (no backpack sprayers).
    f. Spot spray using metsulfuron methyl, and sulfometuron methyl allowed to bankfull level of perennial streams with backpack sprayers, hand-pump sprayers, and squirt bottles.
    g. Spot spray of aquatic labeled glyphosate, imazapyr, metsulfuron methyl, and sulfometuron methyl within dry intermittent and ephemeral channels allowed only with hand-held, hand-pumped sprayers and squirt bottles (no backpack sprayers). Excluding backpack spot spray is a conservation measure intended to minimize overspray within channels, and subsequent "first flush" exposures to aquatic resources, while still allowing full efficacy of the treatment.
    h. For foliar backpack spray applications, use only low pressure sprayers producing droplet sizes between 200 and 800 microns to minimize drift.
    i. Backpack spray activities will only occur during conditions with low drift potential, defined as wind velocities greater than two and less than 10 mph, or as stated on herbicide label.
8. Biological Controls
    a. All biological controls used will be U.S. Animal and Plant Health Inspection Service (APHIS) and state approved.
    b. Agents demonstrated to have direct negative effects on non-target organisms will not be released.

9. Site Preparation and Competitive Planting and Seeding
    a. Minimize ground disturbance by clearing only the area necessary for effective planting.
10. Extent of Treatment
    a. Within each sixth field HUC containing listed aquatic species, no more than 10% of the total riparian area, measured as adjacent stream length, will be treated within any one year period. This includes 10% of flowing streams, and 10% of intermittent streams, measured separately.

Table 5 summarizes design criteria to minimize effects of herbicide application to water quality.

Table 5. Summary of design criteria to minimize effects to water quality

Herbicide	**Perennial/flowing channels**		**Dry intermittent and ephemeral channels, and ditches**	
	Spot spray	**Hand/select**	**Spot spray**	**Hand/select**
Chlorsulfuron	50 feet from bankfull	bankfull	bankfull	allowed through channel/ditch
Clopyralid	15 feet from bankfull	bankfull	bankfull	allowed through channel/ditch
Glyphosate (aquatic)	edge of water[1]	edge of water and emergent knotweed	allowed through channel/ditch	allowed through channel/ditch
Imazapyr	bankfull	Bankfull	allowed through channel/ditch	allowed through channel/ditch
Imazapyr (aquatic)	edge of water[1]	edge of water and emergent knotweed	allowed through channel/ditch	allowed through channel/ditch
Metsulfuron methyl	bankfull	bankfull	allowed through channel/ditch	allowed through channel/ditch
Sethoxydim	15 feet from bankfull	bankfull	bankfull	allowed through channel/ditch
Sulfometuron methyl	bankfull	bankfull	allowed through channel/ditch	allowed through channel/ditch

[1]Backpack sprayer to bankfull, hand-held sprayer within bankfull and emergent knotweed.

Conservation Measures

1. When consistent with label instructions, use water when diluting herbicides prior to application.
2. A spill cleanup kit will be available whenever herbicides are used, transported, or stored.
3. A certified/licensed pesticide applicator will oversee all herbicide application projects.
4. In riparian areas, use only surfactants or adjuvants that do not contain any ingredients on Environmental Protection Agency's List 1 or 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with a high priority for testing

Excluded Activities

No other treatments or techniques for riparian area invasive plant treatments are covered in this consultation.

15. Riparian Exclusion Fencing

Description

The Action Agencies propose to construct and replace fences around riparian areas to restrict or eliminate human and livestock use to maintain or restore stream channel, riparian vegetation, and floodplain functions. Fence types can include the following: Permanent barbed-wire, high-tension, smooth-wire, let-down, electric, buck and pole, and other similar types. Fence construction may involve use of all-terrain vehicles, flatbed trucks, and manual and power tools. Water gap or stream crossing construction may involve dump trucks and excavator-type equipment.

Design Criteria

1. Fence placement should allow for lateral movement of stream.
2. Minimize vegetation removal, especially potential large wood recruitment sources, when constructing fence lines.
3. When constructing livestock crossings and water gaps, use the following design criteria:
    a. Locate crossings or water gaps where streambanks are naturally low.
    b. When possible, crossings and gaps should not be constructed within known or suspected spawning areas (*e.g.* pool tailouts where spawning may occur).
    c. Fences at stream crossings and water gaps should not inhibit upstream or downstream movement of fish or significantly impede bedload movement. Where appropriate, construct fences at water gaps as to allow passage of large wood and other debris.
    d. If necessary, the streambank and approach lanes can be stabilized with native vegetation and angular rock to reduce chronic sedimentation. The stream crossing or water gap should be armored with cobble-size rock, and use angular rock if natural substrate is not of adequate size.
    e. Livestock crossings or water gaps must not be located in areas where compaction or other damage can occur to sensitive soils and vegetation (*e.g.,* wetlands) due to congregating livestock.
    f. The maximum width of a water gap or stream crossings should be no less than 10 feet and no more than 20 feet in the upstream-downstream direction
    g. When using pressure treated lumber for fence posts only, complete all cutting/drilling offsite so that treated wood chips and debris do not enter water or flood prone areas.
4. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures

No additional conservation measures are proposed for this activity category.

Excluded Activities

Riparian fencing is not to be used to create livestock handling facilities or riparian pastures.

16. Riparian Planting

Description

The Action Agencies conduct riparian vegetation planting as a means to help restore plant species composition and structure that would occur under natural disturbance regimes. The resulting benefits to the aquatic system can include desired levels of stream shade, bank stability, stream nutrients, large wood inputs, increased grasses, forbs, and shrubs, and reduced soil erosion. Activities may include the following: planting conifers, deciduous trees and shrubs; placement of sedge and rush mats; gathering and planting willow cuttings. Equipment may include excavators, backhoes, dump trucks, power augers, chainsaws, and manual tools.

Design Criteria

1. An experienced silviculturist, botanist, ecologist, or associated technician shall be involved in designing vegetation treatments.
2. No roads or landings will be constructed.
3. Species to be planted must be the same species that naturally occur in the project area.
4. Tree and shrub species, as well as sedge and rush mats to be used as transplant material, shall come from outside the bankfull width, typically in abandoned flood plains, and where such plants are abundant.
5. Sedge and rush mats should be sized to prevent their movement during high flow events.
6. Concentrate plantings above the bankfull elevation.
7. If other aquatic restoration activities included in this BA are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures

No additional conservation measures are required.

Excluded Activities

No excluded activities are proposed for this activity category.

17. Road Treatments

Description

The Action Agencies propose decommissioning or obliteration of roads to restore watershed function. This activity includes road decommissioning, from simple closures to more complex road obliterations, with an overall goal of restoring hydrologic functions. This category also includes stormproofing roads intended to remain open (hydrologically disconnecting such roads from watershed streams). Associated benefits include the following: Eliminating or reducing erosion and mass-wasting hazards associated with roads; eliminating or reducing human access and use-disturbance associated impacts to aquatic systems. Actions such as bridge and culvert removal, removal of asphalt and gravel, subsoiling or ripping of road surfaces, outsloping, waterbarring, fill removal, sidecast pullback, re-vegetating with native species and placement of large woody material and/or boulders are included. Roadway barricading to exclude vehicular traffic is covered only if the overall road remediation project substantively addresses restoration of hydrologic function. For culvert removals on closed roads, limited cutting or removal of vegetation on the closed road-bed to access the culvert site may be required. Construction would

involve use of heavy equipment, such as excavators, backhoes, front-end loaders, dump trucks, and bull dozers.

Design Criteria

1. For road removal projects within riparian areas, recontour the affected area to mimic natural floodplain contours and gradient to the greatest degree possible.
2. For those road segments immediately adjacent to the stream or where the road fill is near the wetted stream, consider using sediment control barriers between the project and the stream.
3. Drainage features should be spaced to hydrologically disconnect road surface runoff from stream channels.
4. Dispose of slide and waste material in stable sites out of the flood prone area. Waste material other than hardened surface material (asphalt, concrete, etc) may be used to restore natural or near-natural contours.
5. Minimize disturbance of existing vegetation in ditches and at stream crossings to the greatest extent possible.
6. Conduct activities during dry-field conditions – low to moderate soil moisture levels.
7. When removing a culvert from a first or second order, non-fishing bearing stream, project specialists shall determine if culvert removal should follow the isolation criteria as describe in Activity #5 above. Culvert removal on fish bearing streams shall adhere to the measures describe in #5 above.
8. For culvert removal projects, restore natural drainage patterns and when possible promote passage of all fish species and life stages present in the area. Evaluate channel incision risk and construct in-channel grade control structures when necessary.
9. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures

No additional conservation measures are proposed for this activity category.

Excluded Activities

This consultation does not cover new road construction or routine maintenance of existing roads.

18. Removal of Legacy Structures

Description

The Action Agencies propose to remove large wood, boulders, rock gabions, and other in-channel structures that were constructed to improve fish habitat but were installed in a manner that was, and continues to be, inappropriate for the given stream type. Examples of such structures, which were installed in the 1980s and early 1990s, include boulder configurations in meadow streams, stair-step perpendicular log weirs, and rock gabions. These legacy structures typically resulted in widened stream channels, increased width/depth ratios, decreased sinuosity, and increased stream exposure to solar radiation. Removal of legacy structures would include the use of excavator-type machinery, spyders, backhoes, and dump trucks.

Design Criteria

1. If the structure being removed contains material (*i.e.,* large wood, boulders, etc) not typically found within the stream or floodplain at that site, remove material from the 100-year floodplain.
2. If the structure being removed contains material (*i.e.,* large wood, boulders, etc) that is typically found within the stream or floodplain at that site, the material can be reused to implement habitat improvements described under Large Wood, Boulder, and Gravel Placement activity category in this BA following design criteria for Large Wood, Boulder, and Gravel Placement activity category.
3. If the structure being removed is keyed into the bank, fill in "key" holes with native materials to restore contours of streambank and floodplain. Compact the fill material adequately to prevent washing out of the soil during over bank flooding. Do not mine material from the stream channel to fill in "key" holes. Bring in clean top soil, if necessary, to improve vegetation reestablishment.
4. When removal of buried (keyed) structures may result in significant disruption to riparian vegetation and/or the floodplain, consider using a chainsaw to extract the portion of log within the channel, leaving the buried sections within the streambank.
5. If the legacy structures (log, rock, or gabion weirs) were placed to provide grade control, evaluate the site for potential head-cutting and incision due to structure removal. If head-cutting and channel incision are likely to occur due to structure removal, additional measures must be taken to reduce these impacts (see grade control options described under Head-cut Stabilization activity category).
6. If the structure is being removed because it has caused an over-widening of the channel, restoration measures (LW, Boulder, and Gravel Placement activity category) may be implemented to decrease the width to depth ratio of the stream at that location to a level commensurate with upstream and downstream (within the same channel type).
7. Protect riparian vegetation that has grown around legacy structures to the greatest degree possible.
8. If other aquatic restoration activities included in this BA are used as complementary actions, follow the associated design criteria and conservation measures

Conservation Measures

No additional conservation measures are proposed for this activity category.

Excluded Activities

No excluded activities are proposed for this activity category.

19. Fisheries, Hydrology, Geomorphology, Wildlife, Botany, and Cultural Surveys in Support of Aquatic Restoration Activities

Description

The Action Agencies propose to assess and monitor projects that are specifically associated with planning, implementation, and monitoring of aquatic restoration projects covered by this consultation. Such support projects may include surveys to document the following aquatic and riparian attributes: Fish habitat, hydrology, channel geomorpholgy, water quality, fish spawning, fish presence, macroinvertebrates, riparian vegetation, wildlife, and cultural resources

(including excavating test pits <1 m^2 in size). This also includes presence/absence surveys for listed terrestrial wildlife, bird, and plant species in the project area.

Design Criteria

1. Minimize amount of disturbance to fish by training personnel in survey methods that prevent or minimize disturbance of fish. Contract specifications should include these measures where appropriate.
2. Avoid impacts to fish redds. When possible, avoid sampling during spawning periods.
3. Coordinate with other local agencies to prevent redundant surveys.
4. Locate excavated material from cultural resource test pits away from stream channels. Replace all material in test pits when survey is completed and stabilize the surface.

Conservation Measures
No additional conservation measures are proposed for this activity category.

This activity category does not include surveys covered by Section 10 (a) 1a of the ESA.

General Practices and Requirements for Each Activity Category

The Action Agencies propose the following conservation measures for all activites covered by this consultation:

Technical Skill and Planning Requirements
Ensure that an experienced professional fisheries biologist, hydrologist or technician is involved in the design of all projects covered by this consultation. The experience should be commensurate with technical requirements of a project. If ESA-listed wildlife or plant species occur in the planning area, as determined by a unit wildlife biologist or botanist, the appropriate specialist will assist with project design.

1. Planning and design include field evaluations and site-specific surveys, which may include reference reach evaluations that describe the appropriate geomorphic context in which to implement the project. Planning and design involve appropriate expertise from professional staff or experienced technicians (*e.g*. engineer, silviculturist, fire and fuels specialists.)

2. The project biologist shall ensure that design criteria and conservation measures are incorporated into any implementation contract agreements. If a biologist is not the contracting officer's representative (COR), then the biologist must regularly coordinate with the project. COR to ensure the design criteria and conservation measures are being followed.

State and Federal Requirements
1. Follow the appropriate state (ODFW or WDFW) guidelines for timing of in-water work. Exceptions to ODFW and WDFW in-water work windows must be requested and granted from the appropriate state agency. Exceptions can be approved through documented phone conversations or email messages with the state agencies. Such guidelines have been

developed to prevent project implementation in fish spawning habitat when spawning is taking place or while eggs and alevins are in gravel.

2. Project actions will follow all provisions and requirements (including permits) of the Clean Water Act for maintenance of water quality standards as described by Oregon Department of Environmental Quality (Oregon FS and BLM), Washington Department of Ecology (Washington FS and BLM) and the memorandum of understanding between WDFW and the USFS regarding Hydraulic Projects Conducted by USDA Forest Service, Pacific Northwest Region, January 2005.

3. All regulatory permits and official project authorizations will be secured prior to project implementation.

<u>Pollution and Erosion Control Plans (PECP)</u>
The Action Agencies proposes will develop and implement a PECP for each authorized project. The PECP will include methods and measures to minimize erosion and sedimentation associated with the project. The following measures will assist in the creation of a PECP:

1. Spill Prevention Control and Containment Plan (SPCCP) – The contractor will be required to have a written SPCCP, which describes measures to prevent or reduce impacts from potential spills (fuel, hydraulic fluid, etc). The SPCCP shall contain a description of the hazardous materials that will be used, including inventory, storage, handling procedures; a description of quick response containment supplies that will be available on the site (*e.g.*, a silt fence, straw bales, and an oil-absorbing, floating boom whenever surface water is present).

2. The PECP shall be included in construction contracts or force account work plans.

3. The PECP must be commensurate with the scale of the project and include the pertinent elements listed below.
    a. Minimize Site Preparation Impacts
        i. Establish staging areas (used for construction equipment storage, vehicle storage, fueling, servicing, hazardous material storage, *etc.*) beyond the 100-year floodplain in a location and manner that will preclude erosion into or contamination of the stream or floodplain.
        ii. Minimize clearing and grubbing activities when preparing staging, project, and or stockpile areas. Stockpile large wood, trees, vegetation, sand, topsoil and other excavated material, that is removed when establishing area(s) for site restoration.
        iii. Materials used for implementation of aquatic restoration categories (*e.g.* large wood, boulders, fencing material etc.) may be staged within the 100-year floodplain.
        iv. Prior to construction, flag critical riparian vegetation areas, wetlands, and other sensitive sites to prevent ground disturbance in these areas.
        v. Place sediment barriers prior to construction around sites where significant levels of erosion may enter the stream directly or through road ditches. Maintain barriers throughout construction.

vi. Where appropriate, include hazard tree removal (amount and type) in project design. Fell hazard trees within riparian areas when they pose a safety risk. If possible, fell trees towards the stream. Keep felled trees on site when needed to meet coarse woody debris objectives.

b. Minimize Heavy Equipment Impacts

i. The size and capability of heavy equipment will be commensurate with the project.

ii. All equipment used for instream work shall be cleaned and leaks repaired prior to entering the project area. Remove external oil and grease, along with dirt and mud prior to construction. Thereafter, inspect equipment daily for leaks or accumulations of grease, and fix any identified problems before entering streams or areas that drain directly to streams or wetlands.

iii. All equipment shall be cleaned of all dirt and weeds before entering the project area to prevent the spread of noxious weeds.

iv. Equipment used for instream or riparian work shall be fueled and serviced in an established staging area outside of riparian zone. When not in use, vehicles shall be stored in the staging area.

v. Minimize the number and length of stream crossings and access routes through riparian areas. Crossings and access routes should be at right angles. Stream crossings shall not increase risks of channel re-routing at low and high water conditions and shall avoid potential listed fish spawning areas when possible.

vi. Existing roadways or travel paths will be used whenever reasonable. Minimize the number of new access paths to minimize impacts to riparian vegetation and functions.

vii. Project operations must cease under high flow conditions that inundate the project area, except for efforts to avoid or minimize resource damage.

viii. Minimize time in which heavy equipment is in stream channels, riparian areas, and wetlands. Operate heavy equipment in streams only when project specialists believe that such actions are the only reasonable alternative for implementation, or would result in less sediment in the stream channel or damage (short- or long-term) to the overall aquatic and riparian ecosystem relative to other alternatives.

c. Site Restoration

i. Upon project completion, remove project related waste.

ii. Initiate rehabilitation of all disturbed areas in a manner that results in similar or better than pre-work conditions through spreading of stockpiled materials, seeding, and/or planting with local native seed mixes or plants. Planting shall be completed no later than spring planting season of the year following construction.

iii. Short-term stabilization measures may include the use of non-native sterile seed mix (when native seeds are not available), weed-free certified straw, jute matting, and other similar techniques. Short-term stabilization measures will be maintained until permanent erosion control measures are effective. Stabilization measures will be instigated within three days of construction completion.

iv. All riparian plantings shall follow Forest Service direction described in the Regional letter to Units, Use of Native and Nonnative Plants on National Forests and Grasslands May 2006 (Final Draft), and or BLM Instruction Memorandum

No. OR-2001-014, Policy on the Use of Native Species Plant Material (Included in the BA as Appendix B).

v. When necessary, loosen compacted areas, such as access roads, stream crossings, staging, and stockpile areas.

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 C.F.R. 402.02). For purposes of this consultation, the overall action area consists of the combined action areas of each project authorized under this Opinion. This includes riparian and aquatic areas affected by project implementation in the area described in the *Geographic Scope* section of this Opinion. Individual action areas also cover up to 2,500 feet downstream from the project area where aquatic habitat conditions may be temporarily degraded by increased turbidity and fine sediments in stream substrates. All projects authorized by this Opinion will occur within the following areas: (1) Streams and riparian areas on Forest Service, BLM, Coquille lands or private lands adjacent to Federal lands where Wyden amendment projects may occur; and (2) the range of ESA-listed salmon or steelhead, designated critical habitat, or EFH designated under the MSA.

The Action Agencies have concluded that the proposed action for this consultation is "likely to adversely affect" Lower Columbia River (LCR) Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Puget Sound Chinook salmon, Snake River (SR) fall-run Chinook salmon, SR spring/summer-run Chinook Salmon, Upper Willamette River (UWR) Chinook salmon, Columbia River (CR) chum salmon, Hood Canal summer-run chum salmon, SR sockeye salmon, Southern Oregon/Northern California Coasts (SONCC) coho salmon, OC coho salmon, LCR coho salmon, LCR steelhead, Middle Columbia River (MCR) steelhead, UCR steelhead, SR Basin steelhead, UWR steelhead, and Puget Sound (PS) steelhead. The action areas provide spawning, rearing, and migration habitat for these species and many action areas will be within designated critical habitat for these species. Southern DPS green sturgeon uses the estuary and lower river portions of the action area as habitat for growth and development to adulthood and for adult feeding.

Action areas involved in this consultation are also designated as EFH for Pacific Coast groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and/or Pacific Coast salmon (PFMC 1999), or are in areas where environmental effects of the proposed project may adversely affect designated EFH for those species.

The Action Agencies have provided information in the BA regarding the number of projects they expect to cover with this consultation. This projection was developed by examining information from an interagency database on restoration actions (IRDA). Information from 1998 to 2004 shows that the Action Agencies carry out an average of 166 aquatic restoration projects per year in Oregon and Washington. Each project typically treats an average of 1.24 miles of stream. From 1998 to 2004, the total stream length treated each year averaged 119 miles and the riparian area treated averaged approximately 43 acres. The Action Agencies expect to receive similar funding for restoration projects for the next several years, so NMFS will assume for the purposes

of this consultation that restoration actions will continue to occur at levels similar or slightly higher than in the past.

ENDANGERED SPECIES ACT

The ESA establishes a national program to conserve 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 NMFS to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitats. Section 7(b)(4) requires the provision of an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts.

Biological Opinion

This Programmatic Opinion presents NMFS' review of the status of each listed species of Pacific salmon and steelhead[3] considered in this consultation, the condition of designated critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects (50 CFR 402.14(g)). For the jeopardy analysis, 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 listed species. Information about southern DPS green sturgeons and the expected effects of the proposed action on this species is included in the status of the species, environmental baseline, and effects of the action sections of this Opinion.

The critical habitat analysis determines whether the proposed action will destroy or adversely modify designated critical habitat for listed species by examining any change in the conservation value of the essential features of that critical habitat. The regulatory definition of "destruction or adverse modification" at 50 CFR 402.02 is not used in this analysis. Instead, the analysis relies on statutory provisions of the ESA, including those in section 3 that define "critical habitat" and "conservation," in section 4 that describe the designation process, and in section 7 that sets forth the substantive protections and procedural aspects of consultation, and on agency guidance[4] for application of the "destruction or adverse modification" standard.

Status of the Species and Critical Habitat

This section defines the biological requirements of each listed species affected by the proposed action, and the status of each designated critical habitat relative to those requirements. Listed species facing a high risk of extinction and critical habitats with degraded conservation value are

[3] An 'evolutionarily significant unit' (ESU) of Pacific salmon (Waples 1991) and a 'distinct population segment' (DPS) of steelhead (1/05/06; 71 FR 834) are considered to be 'species,' as defined in section 3 of the ESA.

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

more vulnerable to the aggregation of effects considered under the environmental baseline, the effects of the proposed action, and cumulative effects.

Status of the Species. The NMFS reviews the condition of the listed 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 abundance; productivity, spatial structure, and genetic diversity that maintain its capacity to adapt to various environmental conditions and allow it sustain itself 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.

The species addressed by this consultation are those for which the action agencies and NMFS determined the project would likely adversely affect (during restoration construction activities or until the benefits of habitat restoration accrue). These include the following: (1) Lower Columbia River Chinook salmon, (2) Upper Columbia River spring-run Chinook salmon, (3) Puget Sound Chinook salmon, (4) Snake River fall-run Chinook salmon, (5) Snake River spring/summer run Chinook Salmon, (6) Upper Willamette River Chinook salmon, (7) Columbia River chum salmon, (8) Hood Canal summer-run chum salmon, (9) Snake River sockeye salmon, (10) Southern Oregon/Northern California coho salmon, (11) Lower Columbia coho salmon, (12) Oregon Coast coho salmon, (13) Lower Columbia River steelhead, (14) Middle Columbia River steelhead, (15) Upper Columbia River steelhead, (16) Snake River Basin steelhead, (17) Upper Willamette River steelhead; and (18) Puget Sound steelhead. This section also includes the status of the southern DPS of green sturgeon. Table 6 lists Federal Register notices for final rules that list threatened and endangered species, designate critical habitats, or apply protective regulations to listed species considered in this consultation This section covers the status of the green sturgeon because this document expresses NMFS's determination that the proposed fish habitat restoration activities are not likely to adversely affect (NLAA) this species.

Table 6. Federal Register notices for final rules that list threatened and endangered species, designate critical habitats, or apply protective regulations to listed species considered in this consultation. (Listing status: 'T' means listed as threatened under the ESA; 'E' means listed as endangered; 'P' means proposed).

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)			
Lower Columbia River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Willamette River spring-run	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Columbia River spring-run	E 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	ESA section 9 applies
Snake River spring/summer run	T 6/28/05; 70 FR 37160	10/25/99; 64 FR 57399	6/28/05; 70 FR 37160
Snake River fall-run	T 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	6/28/05; 70 FR 37160
Puget Sound	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Chum salmon *(O. keta*)			
Columbia River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Hood Canal	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Coho salmon (*O. kisutch*)			
Lower Columbia River	T 6/28/05; 70 FR 37160	Not applicable	6/28/05; 70 FR 37160
Southern Oregon / Northern California Coasts	T 6/28/05; 70 FR 37160	5/5/99; 64 FR 24049	6/28/05; 70 FR 37160
Oregon Coast coho salmon	T 73 FR 7816	5/12/08; 73 FR 7816	5/12/08; 73 FR 7816
Sockeye salmon (*O. nerka*)			
Snake River	E 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	ESA section 9 applies
Steelhead (*O. mykiss*)			
Lower Columbia River	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Willamette River	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Middle Columbia River	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Columbia River	E[5]	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Snake River Basin	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Puget Sound	T 3/29/06: 71 FR 15666	Not applicable	P 2/7/07; 72 FR 5648
Green Sturgeon (*Acipenser medirostris)*			
Southern DPS	T 4/7/06 71 FR 17757	Not applicable	Not applicable

Lower Columbia River (LCR) Chinook Salmon. The status of LCR Chinook was initially reviewed by NMFS in 1998 (Myers *et al.* 1998) and updated by the biological review team (BRT) in that same year (NMFS 1998). In the 1998 update, the BRT noted several concerns for this listed species. The BRT was concerned that there were very few naturally self-sustaining populations of native Chinook salmon remaining in the LCR. A majority of the previous (1998) BRT concluded that the LCR Chinook salmon were likely to become endangered in the foreseeable future. A minority felt that LCR Chinook salmon were not presently in danger of extinction, nor were they likely to become so in the foreseeable future.

[5] On June 13, 2007, the District Court for the Western District of Washington set aside the downlisting of UCR steelhead and ordered that the initial listing determination of UCR steelhead as endangered remains in effect (*Trout Unlimited v. Lohn*, No. 06-0483-JCC) (Trout Unlimited et al. 2007), case on appeal to the Ninth Circuit Court of Appeals, No. 07-35750. Critical habitat was designated on September 2, 2005, with an effective date of January 2, 2006. The take prohibitions of section 9 of the ESA apply to this DPS."

New data acquired for the Good *et al.* (2005) report includes spawner abundance estimates through 2001, new estimates of the fraction of hatchery spawners and harvest estimates. In addition, estimates of historical abundance have been provided by the WDFW. Information on recent hatchery releases was also obtained. New analyses include the designation of relatively demographically independent populations, recalculation of previous BRT metrics with additional years data, estimates of median annual growth rate under different assumptions about the reproductive success of hatchery fish, and estimates of current and historically available kilometers of stream.

A majority (71%) of the BRT votes for LCR Chinook salmon fell in the "likely to become endangered" category, with minorities falling in the "danger of extinction" and "not likely to become endangered" categories. Moderately high concerns for all VSP elements are indicated by estimates of moderate to moderately high risk for abundance and diversity. All of the risk factors identified in previous reviews were still considered important by the BRT. The Willamette/Lower Columbia River Technical Review Team has estimated that 8-10 historic populations have been extirpated, most of them spring-run populations. Near loss of that important life history type remains an important BRT concern. Although some natural production currently occurs in 20 or so populations, only one exceeds 1,000 spawners. High hatchery production continues to pose genetic and ecological risks to natural populations and to mask their performance. Most LCR Chinook salmon populations have not seen increases in recent years as pronounced as those that have occurred in many other geographic areas.

Limiting factors identified for this species include: (1) Reduced access to spawning/rearing habitat in tributaries, (2) hatchery impacts, (3) loss of habitat diversity and channel stability in tributaries, (4) excessive fine sediment in spawning gravels, (5) elevated water temperature in tributaries, and (6) harvest impacts (NMFS 2005).

Upper Willamette River (UWR) Spring-Run Chinook Salmon. The status of UWR Chinook salmon was initially reviewed by NMFS' BRT in 1998 (Myers *et al.* 1998) and updated in that same year (NMFS 1998). In the 1998 update, the BRT was concerned about the few remaining populations of UWR spring Chinook salmon, and the high proportion of hatchery fish in the remaining runs. The BRT noted with concern that the ODFW was able to identify only one remaining naturally reproducing population for this species: the spring Chinook salmon in the McKenzie River. The BRT was concerned that severe declines in short-term abundance had occurred, and that the McKenzie River population had declined precipitously, indicating that it may not be self-sustaining. The 1998 BRT also noted the potential for interactions between native spring-run and introduced fall-run Chinook salmon had increased relative to historical times due to fall-run Chinook salmon hatchery programs and the laddering of Willamette Falls. The BRT partially attributed the declines in UWR spring Chinook salmon to the extensive habitat blockages caused by dam construction. The BRT was encouraged by efforts to reduce harvest pressure on naturally-produced spring Chinook salmon in Upper Willamette River tributaries, and noted that the increased focus on selective marking of hatchery fish should help managers targeting specific populations of wild or hatchery Chinook salmon.

Another BRT document (Good *et al.* 2005) covered additional viability parameters, including: data regarding spawner abundance through 2002 in the Clackamas River, 2001 in the McKenzie

River, and 2001 at Willamette Falls; updated redd surveys in the basin; new estimates of the fraction of hatchery-origin spawners in the McKenzie and North Santiam Rivers; the first estimate of hatchery fraction in the Clackamas River (2002 data); and information on recent hatchery releases. This update also included data on the designation of relatively demographically independent populations, recalculation of previous BRT metrics in the McKenzie River with additional years of data, estimates of current and historically available kilometers of stream, and updates on current hatchery releases.

The updated information provided in the BRT report (Good *et al.* 2005), the information contained in previous UWR Chinook status reviews, and preliminary analysis by the Willamette/Lower Columbia technical recovery team indicate that most natural spring Chinook populations are likely extirpated or nearly so. The only population considered potentially self-sustaining is the McKenzie River population. However, abundance in this population has been relatively low (low thousands) with a substantial number of these fish being of hatchery origin. The population increased substantially in 2000-2003, probably due to increased survival in the ocean. Future survival rates in the ocean are unpredictable, and the likelihood of long-term sustainability for this population has not been determined.

Although the number of adult spring-run Chinook salmon crossing Willamette Falls is in the same range (about 20,000 to 70,000 adults) it has been for the last 50 years, a large fraction of these are hatchery produced. The score for spatial structure in BRT (Good *et al.* 2003) reflects its concern that perhaps a third of the historical habitat used by this species is inaccessible (behind dams), and that natural production is restricted to very few areas. Increases from 2000-2003 in natural production in the largest remaining population (the McKenzie River population) were considered encouraging by the BRT. With the relatively large incidence of hatchery fish, it is difficult to determine trends in natural production.

A majority (70%) of the BRT votes for this species fell in the "likely to become endangered" category, with minorities falling in the "danger of extinction" and "not likely to become endangered" categories. The BRT found moderately high risks in all VSP elements, with risk estimates ranging from moderate for growth rate/productivity to moderately high for spatial structure.

Limiting factors identified for this species include: (1) Reduced access to spawning/rearing habitat in tributaries, (2) hatchery impacts, (3) altered water quality and temperature in tributaries, (4) altered stream flow in tributaries, and (5) lost/degraded floodplain connectivity and lowland stream habitat (NMFS 2005).

Upper Columbia River (UCR) Spring-Run Chinook Salmon. The UCR spring-run Chinook salmon was reviewed by the West Coast Biological Review Team (BRT) in late 1998 (NMFS 1998). The BRT was mostly concerned about risks falling under the abundance/distribution and trends/productivity risk categories. The BRT was concerned that at these population sizes, negative effects of demographic and genetic stochastic processes are likely to occur. Furthermore, both long- and short-term trends in abundance were declining, many strongly so. The BRT noted that the implementation of emergency natural broodstocking and captive broodstocking efforts indicated the severity of the population declines to critically

small sizes. Habitat degradation, blockages and hydrosystem passage mortality all have contributed to the significant declines.

An initial set of population definitions for UCR spring-run Chinook salmon species along with basic criteria for evaluating the status of each population were developed using the VSP guidelines described in McElhany *et al.* (2000). The historical status of spring-run Chinook salmon production in the Okanogan River is uncertain. The committee deferred a decision on the Okanogan to the Technical Recovery Team. Abundance, productivity and spatial structure criteria for each of the UCR Chinook salmon populations were developed and are described in Ford *et al.* (2001).

Many UCR Chinook salmon populations have rebounded somewhat from the critically low levels that immediately preceded the last status review evaluation. Although this was considered an encouraging sign by the BRT, the last year or two of higher returns come on the heels of a decade or more of steep declines to all time record low escapements. In addition, hatchery production from both production/mitigation and supplementation programs continues to have a large influence on UCR Chinook salmon. The extreme management measures taken in an effort to maintain UCR Chinook salmon populations during some years in the late 1990s (collecting all adults from major basins at downstream dams) are a strong indication of the ongoing risks to UCR Chinook salmon, although the associated hatchery programs may ultimately play a role in helping to restore self-sustaining natural populations.

Assessments by the latest BRT of the overall risks faced by UCR Chinook salmon were divided, with a slight majority (53%) of the votes being cast in the "danger of extinction" category and a minority (45%) in the "likely to be endangered" category. The risk estimates reflect strong ongoing concerns regarding abundance and growth rate/productivity (high to very high risk) and somewhat less (but still significant) concerns for spatial structure (moderate risk) and diversity (moderately high risk).

Limiting factors identified for this species include: (1) Mainstem Columbia River hydropower system mortality, (2) tributary riparian degradation and loss of in-river wood, (3) altered tributary floodplain and channel morphology, (4) reduced tributary stream flow and impaired passage, and (5) harvest impacts.

Snake River (SR) Spring/Summer-Run Chinook Salmon. This species occupies the Snake River basin, which drains portions of southeastern Washington, northeastern Oregon, and north/central Idaho. Environmental conditions are generally drier and warmer in these areas than in areas occupied by other Chinook species. Chinook-producing drainages occupied by the SR spring/summer-run Chinook salmon include the Grande Ronde, Imnaha, Salmon, and Tucannon river systems.

SR spring/summer-run Chinook salmon exhibit a stream-type life history. Juvenile fish mature in fresh water for one year before they migrate to the ocean in the spring of their second year. Adults re-enter the Columbia River in late February and early March after two or three years in the ocean. In high elevation areas, mature fish hold in cool, deep pools until late summer and early fall, when they return to their native streams to begin spawning. Eggs incubate through the

fall and winter and emergence begins in the late winter and early spring. Juveniles migrate through the action area starting in early May through the middle of June.

Although direct estimates of historical annual SR spring/summer run Chinook returns are not available, returns may have declined by as much as 97% between the late 1800s and 2000. According to Matthews and Waples (1991), total annual SR spring/summer Chinook production may have exceeded 1.5 million adult fish in the late 1800s. Total (natural + hatchery origin) returns fell to roughly 100,000 spawners by the late 1960s (Fulton 1968) and were below 10,000 by 1980. Between 1981 and 2000, total returns fluctuated between extremes of 1,800 and 44,000 fish. The 2001 and 2002 total returns increased to over 185,000 and 97,184 adults, respectively. However, it is important to note that over 80% of the 2001 return and over 60% of the 2002 return originated in hatcheries (Good *et al.* 2005).

The Interior Columbia Basin Technical Recovery Team (ICBTRT) has identified 32 populations in 5 major population groups (Upper Salmon River, South Fork Salmon River, Middle Fork Salmon River, Grande Ronde/Imnaha, Lower Snake Mainstem Tributaries) for this species. Historic populations above Hells Canyon Dam are considered extinct (ICBTRT 2003).

Thus, despite the recent increases in total spring/summer-run Chinook salmon returns to the basin, natural origin abundance and productivity are still below their targets. The BRT has noted that SR spring/summer Chinook salmon remains likely to become endangered (Good *et al.,* 2005).

Limiting factors identified for this species include: (1) Mainstem lower Snake and Columbia hydrosystem mortality, (2) reduced tributary stream flow, (3) altered tributary channel morphology, (4) excessive fine sediment in tributaries, (5) degraded tributary water quality (NMFS 2005b).

Snake River (SR) Fall-Run Chinook Salmon. SR fall-run Chinook spawn above Lower Granite Dam in the mainstem Snake River and in the lower reaches of the larger tributaries. Adult SR fall-run Chinook salmon enter the Columbia River in July and August. Spawning occurs from October through November. Juveniles emerge from the gravels in March and April of the following year, moving downstream from natal spawning and early rearing areas from June through early fall.

The NMFS BRT recently completed a status review of SR fall-run Chinook salmon and concluded that the species is "likely to become endangered" (Good *et al.* 2005). The BRT found moderate risk to the species for productivity and moderately high risks for abundance, spatial structure, and diversity. The paragraphs below summarize information from BRT, ICBTRT, and other sources on the status of Snake River fall-run Chinook salmon in terms of those four viability components.

The estimated annual return for the period 1938-1949 was 72,000 fish; and by the 1950s, numbers had declined to an annual average of 29,000 fish. Numbers of SR fall-run Chinook salmon continued to decline during the 1960s and 1970s as approximately 80% of their historic habitat was eliminated or severely degraded by the construction of the Hells Canyon complex

(1958–1967) and the lower Snake River dams (1961–1975). Counts of natural-origin adult SR fall-run Chinook salmon at Lower Granite Dam were 1000 fish in 1975, and ranged from 78 to 905 fish (with an average of 489 fish) over the ensuing 25-year period through 2000 (Good *et al.* 2005). Numbers of natural-origin SR fall-run Chinook salmon have increased over the last few years, with estimates at Lower Granite dam of 2,652 fish in 2001 (Good *et al.* 2005), 2,095 fish in 2002, and 3,895 fish in 2003.

Similarly, hatchery-origin returns of SR fall-run Chinook salmon have increased in recent years. The Lyons Ferry Hatchery, which is in the lower Snake River near the mouth of the Palouse River, had returns of approximately 1,000-2,000 fish to the hatchery during the period 1999-2001. In addition, more than 5,000 hatchery-origin SR fall-run Chinook salmon were counted at Lower Granite Dam in 2001, whereas counts had been no more than a few hundred fish annually prior to 2000 (Good *et al.* 2005). The hatchery-origin adults passing Lower Granite Dam are largely Lyons Ferry fish that were released above the dam as juveniles; there are also fish from the Idaho Power Hatchery on the Snake River and Nez Perce Tribal Hatchery on the Clearwater River. The Nez Perce Tribal Hatchery has been in operation for three years, and just reached target production levels in 2005; therefore, its full effects on numbers of returning adults are not yet known. SR fall-run Chinook salmon redd counts also reflect the low abundances of the 1980s and 1990s and the increases in numbers of both natural-origin and hatchery-origin fish during the last few years. From 1986 to 2000, redd counts for fall-run Chinook salmon in the Snake River and tributaries upriver from Lower Granite Dam ranged from 7 to 586 redds, with an average of 178 redds annually. There have been notable and steady increases in the number of redds since 2000, with a count of 1,303 redds in 2001, 1,854 redds in 2002, 2,241 redds in 2003, and 2,562 redds in 2004 (Garcia *et al.* 2005, p.16).

The ICBTRT has defined only one extant population for the SR fall-run Chinook salmon, the Lower Snake River mainstem population. This population occupies the Snake River from its confluence with the Columbia River to Hells Canyon Dam, and the lower reaches of the Clearwater, Imnaha, Grande Ronde, Salmon, and Tucannon Rivers (ICBTRT 2003).

The BRT concluded that, although Snake River fall-run Chinook salmon numbers have been increasing in recent years, there remains a moderately high risk of extinction due to insufficient abundance (Good *et al.* 2005). Sustained abundance of natural origin fish at current levels or higher will decrease long-term risks to the species.

Limiting factors identified for Snake River fall-run Chinook salmon include: (1) Mainstem lower Snake and Columbia hydrosystem mortality, (2) degraded water quality, (3) reduced spawning and rearing habitat due to mainstem lower Snake River hydropower system, and (4) harvest impacts (NMFS 2005b).

Puget Sound Chinook Salmon. 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 (NMFS-TRT 2001). 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.

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 2004). 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.

Limiting factors for Puget Sound Chinook salmon include: (1) Degraded floodplain and in-river channel structure, (2) degraded estuarine conditions and loss estuarine habitat, (3) riparian area degradation and loss of in-river large woody debris, (4) excessive sediment in spawning gravels, (5) degraded water quality and temperature (NMFS 2005b).

Columbia River (CR) Chum Salmon. NMFS provided an updated status report on CR chum in 1999 (NMFS 1999). As documented in the 1999 report, the BRT was concerned about the dramatic declines in abundance and contraction in distribution from historical levels. The BRT was also concerned about the low productivity of the extant populations, as evidenced by flat trend lines at low population sizes. A majority of the BRT concluded that the CR chum salmon ESU was likely to become endangered in the foreseeable future and a minority concluded that the ESU was currently in danger of extinction.

New data includes spawner abundance through 2000, with a preliminary estimate in 2002, new information on the hatchery program, and new genetic data describing the current relationship of spawning groups. New analyses include designation of relatively demographically independent populations, recalculation of previous BRT metrics with additional years data, estimates of median annual growth rate, and estimates of current and historically available kilometers of stream.

Updated information provided in the Good *et al.* (2005), the information contained in previous Lower Columbia River status reviews, and preliminary analyses by the Willamette/Lower Columbia Technical Review Team suggest that 14 of the 16 historical populations (88%) are extinct or nearly so. The two extant populations have been at low abundance for the last 50 years in the range where stochastic processes could lead to extinction. Encouragingly, there has been a substantial increase in the abundance of these two populations. In addition there are the new (or newly discovered) Washougal River mainstem spawning groups. However, it is not known if the increase will continue and the abundance is still substantially below the historical levels.

Nearly all of the likelihood votes for this ESU fell in the "likely to become endangered" (63%) or "danger of extinction" (34%) categories. The BRT had substantial concerns about every VSP element, as indicated risk estimates scores that ranged from moderately high for growth rate/productivity to high to very high for spatial structure. Most or all of the risk factors identified previously by the BRT remain important concerns. The Willamette/Lower Columbia Technical Review Team has estimated that close to 90% of the historical populations in the ESU are extinct or nearly so, resulting in loss of much diversity and connectivity between populations. The populations that remain are small, and overall abundance for the ESU is low. This ESU has showed low productivity for many decades, even though the remaining populations are at low abundance and density dependent compensation might be expected. The BRT was encouraged that unofficial reports for 2002 suggest a large increase in abundance in some (perhaps many) locations. Whether this large increase is due to any recent management actions or simply reflects unusually good conditions in the marine environment is not known at this time, but the result is encouraging, particularly if it were to be sustained for a number of years.

Limiting factors identified for Columbia River Chum Salmon include: (1) altered channel form and stability in tributaries, (2) excessive sediment in tributary spawning gravels, (3) altered stream flow in tributaries and mainstem Columbia, (4) loss of some tributary habitat types, and (5) harassment of spawners in tributary and Columbia mainstem (NMFS 2005b).

Hood Canal Summer-Run Chum Salmon. This ESU 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 species (NMFS, 2005a).

Adult returns for some populations in the Hood Canal summer-run chum species 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 species, 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% 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 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 (NMFS 2004a). 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 (Good *et al.* 2005) 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, 2004a).

Limiting factors identified for this species include: (1) Degraded floodplain and mainstem river channel structure, (2) Degraded estuarine conditions and loss of estuarine habitat, (3) Riparian area degradation and loss of in-river wood in mainstem, (4) Excessive sediment in spawning gravels, (5) reduced stream flow in migration areas (NMFS 2005b).

Lower Columbia River (LCR) Coho Salmon. The status of LCR coho salmon was initially reviewed by NMFS in 1996 and the most recent review occurred in 2001. In the 2001 review, the BRT was very concerned that the vast majority (over 90%) of the historical populations of LCR coho salmon appear to be either extirpated or nearly so. The two populations with any significant production (Sandy and Clackamas) were at appreciable risk because of low abundance, declining trends, and failure to respond after a dramatic reduction in harvest. The large number of hatchery coho salmon in the ESU was also considered an important risk factor. The majority of the 2001 BRT votes were for "at risk of extinction" with a substantial minority in "likely to become endangered."

Since the status of the LCR coho salmon was reviewed by the BRT in 2000, relatively little new information was available for the 2003 review. A majority (68%) of the 2003 likelihood votes for LCR coho salmon fell in the "danger of extinction" category, with the remainder falling in the "likely to become endangered" category. As indicated by the risk matrix totals, the BRT had major concerns for this ESU in all VSP risk categories (risk estimates ranged from high risk for spatial structure/connectivity and growth rate/productivity to very high for diversity). The most serious overall concern was the scarcity of naturally-produced spawners, with attendant risks associated with small population, loss of diversity, and fragmentation and isolation of the remaining naturally-produced fish. In the only two populations with significant natural production (Sandy and Clackamas), short- and long-term trends are negative and productivity (as gauged by pre-harvest recruits) is down sharply from recent (1980s) levels.

Southern Oregon/North California Coasts (SONCC) Coho Salmon. SONCC coho salmon extend from Cape Blanco in southern Oregon to Punta Gorda in northern California (Weitkamp *et al.* 1995). The status of coho salmon coastwide, including the SONCC coho ESU, was formally assessed in 1995 (Weitkamp *et al.* 1995). Two subsequent status review updates

have been published by NMFS, one addressing all West Coast coho salmon ESUs (NMFS 1996) and a second specifically addressing the OC and SONCC ESUs (NMFS 1997).

In the 1995 status review, the BRT was unanimous in concluding that SONCC coho salmon were not in danger of extinction but were likely to become so in the foreseeable future if present trends continued (Weitkamp *et al.* 1995). In the 1997 status update, estimates of natural population abundance were based on very limited information. New data on presence/absence in northern California streams that historically supported coho salmon were even more disturbing than earlier results, indicating that a smaller percentage of streams contained coho salmon compared to the percentage presence in an earlier study. However, it was unclear whether these new data represented actual trends in local extinctions, or were biased by sampling effort. This new information did not change the BRT's conclusion regarding the status of SONCC coho salmon.

New data for the SONCC coho salmon ESU includes expansion of presence/absence analyses, a limited analysis of juvenile abundance in the Eel River basin, a few indices of spawner abundance in the Smith, Mad, and Eel river basins, and substantially expanded monitoring of adults, juveniles, and habitat in southern Oregon. None of these data contradict conclusions reached previously by the BRT. Nor do any of recent data (1995 to present) suggest any marked change, either positive or negative, in the abundance or distribution of SONCC coho salmon.

The BRT remained concerned about low population abundance relative to historical numbers and long-term downward trends in abundance; however, the paucity of data on escapement of naturally-produced spawners in most basins continued to hinder assessment of risk. The BRT also remains concerned about the possibility that losses of local populations have been masked in basins with high hatchery output, including the Trinity, Klamath, and Rogue systems. The extent to which strays from hatcheries in these systems are contributing to natural production remains uncertain, however, it is generally believed that hatchery fish and progeny of hatchery fish constitute the majority of production in the Trinity River, and may be a significant concern in parts of the Klamath and Rogue systems a well. On the positive side, extant populations can still be found in all major river basins within the ESU. Additionally, the relatively high occupancy rate of historical streams observed in broodyear 2001 suggests that much habitat remains accessible to coho salmon. The BRT's concern for the large number of hatchery fish in the Rogue, Klamath, and Trinity systems was also evident in the moderate risk rating for diversity.

A majority (67%) of BRT votes fell into the "likely to become endangered" category, while votes in the "endangered" category outnumbered those in the "not warranted" categories by 2-to-1. The BRT found moderately high risks for abundance and growth rate/production, with mean matrix scores of 3.5 to 3.8, respectively, for these two categories. Risks to spatial structure and diversity were judged by the BRT to be moderate.

Limiting factors identified for this species include: (1) Loss of channel complexity, connectivity and sinuosity, (2) loss of floodplain and estuarine habitats, (3) loss of riparian habitats and large in-river wood, (4) reduced streamflow, (5) poor water quality, temperature and excessive sedimentation, and (6) unscreened diversions and fish passage structures (NMFS 2005a).

Oregon Coastal (OC) coho salmon. This species includes all naturally-spawned populations of coho salmon in Oregon coastal streams south of the Columbia River and north of Cape Blanco, and progeny of five artificial propagation programs. The Oregon Coast Technical Recovery Team (OC-TRT) identified 56 historical populations, grouped into five major "biogeographic strata," based in consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity (Lawson *et al*. 2004). Throughout the action area, the Yaquina River population of OC coho are "functionally independent". A "functionally independent" population is one that is so dominating (generally in the largest basins) that their population demographics are acting in manner that is functionally independent from all other populations.

The Yaquina River population is one of four functionally independent populations within the Mid-coast Stratum. Two other populations are potentially independent. As shown in Table 7, with the exception of Mill Creek, the majority of the OC coho spawning in the Yaquina River basin takes place above the PME project.

Table 7. Summary of Yaquina Basin OC coho salmon spawning ground surveys 2001-2008. Shaded areas show survey segments within the PME action area. Streams on the table above and below the shaded area are downstream and upstream respectively.

	2007-08		**2006-07**		**2005-06**		**2004-05**		**2003-04**		**2002-03**		**2001-02**	
	A	**J**	**A**	**J**	**A**	**J**	**A**	**J**	**A**	**J**	**A**	**J**	**A**	**J**
Wright Creek													47	3
Wright Creek Trib B	0	0												
Elk Creek	5	1	3	0					12	1	26	3		
Twenty-Three Creek	11	2	4	1										
Drake Creek			0	0							4	0	0	0
Olalla Creek Trib A			0	0										
W. Olalla Creek			38	4										
W. Olalla Creek Trib A			15	1										
Arnold Creek											11	6		
Montgomery Creek	0	0												
Beaver Creek	3	0	9	0			9	0			90	4	21	2
Beaver Creek Trib A	13	1	8	0										
Little Beaver Creek			0	0							51	10		
Devil's Well Creek			4	0										
Upper Mill Creek									165	5				
EF Mill Creek									177	8				
Mill Creek	2	0	71	3			15	2	191	8			2	0
Depot Creek Trib A														
Bear Creek					9	3					17	2		
Abbey Creek							0	0						
Hayes Creek							7	2						
Thornton Creek													8	3
Trapp Creek	7	1												
Crystal Creek			2	0							6	0		
Little Elk Creek			2	0										
Little Elk Creek Trib A									8	1				
Young Creek	0	0	1	0			4	0	7	1			1	1

	2007-08		2006-07		2005-06		2004-05		2003-04		2002-03		2001-02	
	A	**J**	**A**	**J**	**A**	**J**	**A**	**J**	**A**	**J**	**A**	**J**	**A**	**J**
Spilde Creek	0	0												
Humphrey Creek			3	0										
Randall Creek			0	0									3	1
Upper Bales Creek									55	1				
Cougar Creek	14	2			42	1								
Salmon Creek	10	1	16	1	36	5	17	3	41	7	95	6	24	5
Bull Creek	10	0												
Yaquina River Mainstem	59	2	23	1	51	1	132	3	160	8	236	8	49	6
Wolf Creek			3	0							43	1		
Wolf Creek Trib C	7	1												
Savage Creek	4	0	6	1			7	0			84	2	9	2
Deer Creek			7	1					68	12				
Deer Creek Trib A			0	0										
Spout Creek	3	1	1	0	25	3	20	2	27	1	44	4	18	3
Spout Creek Trib B			3	0										
Sugarbowl	7	0					15	1						
Adams Creek													2	1
Adams Creek Trib B	1	0												
Oglesby Creek	0	0	5	2	12	0	3	0	6	1	17	2	5	2
Wakefield Creek	1	0	6	1									4	0
Miller Creek	10	0												
Carlisle Creek			10	1										
Buttermilk Creek			0	0							134	12		
Felton Creek											9	1		

The OC-TRT concluded that, if recent past conditions continue into the future, OC coho salmon are moderately likely to persist over a 100-year period without artificial support, and have a low to moderate likelihood of being able to sustain their genetic legacy and long-term adaptive potential for the foreseeable future (Wainwright *et al*. 2007).

The following factors were identified by NMFS (2007) as limiting the recovery of OC coho salmon: degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian areas and large wood debris recruitment, degraded stream substrate, degraded water quality, predation, competition, and disease.

In its 2003 viability assessment (Good *et al*. 2005), NMFS' Biological Review Team (BRT) found several positive trends compared to the previous assessment in 1997. Adult spawners for the species in 2001 and 2002 exceeded the number observed for any year in the past several decades, and pre-harvest run size rivaled some of the high values seen in the 1970s. Some notable increases in spawners have occurred in many streams in the northern part of the ESU, which was the most depressed area at the time of the last status review evaluation. Hatchery reforms have continued, and the fraction of natural spawners that are first-generation hatchery fish has been reduced in many areas compared to highs in the early to mid 1990s.

On the other hand, the recent years of good returns were preceded by 3 years of low spawner escapements, the result of 3 consecutive years of recruitment failure, in which the natural

spawners did not replace themselves, even in the absence of any directed harvest. These 3 years of recruitment failure, which immediately followed the last status review in 1997, are the only such instances that have been observed in the entire time series of data collected for OC coho salmon. Whereas the recent increases in spawner escapement have resulted in long-term trends in spawners that are generally positive, the long-term trends in productivity in this species are still strongly negative. Returns of wild coho began declining again in 2003 and continued to decline through 2004, 2005 (see *http://nrimp.dfw.state.or.us/crl/reports/OASIS/CoastalCohoESUSpawnHarvestSummary.pdf*), 2006 (see *http://oregonstate.edu/dept/ODFW/spawn/pdf%20files/coho/2006FinalPopEst.pdf*) and 2007 (see *http://oregonstate.edu/dept/ODFW/spawn/pdf%20files/coho/CoastalCohoESUSpawnHarvestSummary.pdf*)

Low returns have been documented for coastal coho salmon. In Oregon, spawner estimates for the Oregon Coast natural (OCN) coho salmon were less than 25% of predicted returns and 30% of parental spawner abundance. These returns are the lowest since 1999, approaching the low abundances of the 1990s.

For coho salmon there is a clear north/south gradient, with returns improving to the north. California and Oregon coastal returns were down sharply, while Columbia River hatchery coho were down only slightly (82% of prediction). Even within the OCN region, there was a clear north-south pattern, with the north coast region (predominantly Nehalem River and Tillamook Bay populations) returning at 46% of parental abundance while the mid-south coast region (predominantly Coos and Coquille populations) returned at only 14% of parental abundance.

The BRT considered the decline in productivity to be the most serious concern for this species, giving it a "moderate" risk estimate. With all directed harvest for these populations already eliminated, harvest management can no longer compensate for declining productivity by reducing harvest rates. The BRT was concerned that if the long-term decline in productivity reflects deteriorating conditions in freshwater habitat, this species could face very serious risks of local extinctions during the next cycle of poor ocean conditions. With the cushion provided by strong returns in 2 to 3 recent years, the BRT had much less concern about short-term risks associated with abundance and assigned them a "low" risk estimate.

A minority of the BRT felt that the large number of spawners in the last few years demonstrate that this species is not currently at significant risk of extinction or likely to become endangered. Furthermore, these members felt that the recent years of high escapement, following closely on the heels of the years of recruitment failure, demonstrate that populations in this species have the resilience to bounce back from years of depressed runs.

The BRT votes reflected ongoing concerns for the long-term health of this species: A majority (56%) of the BRT votes were cast in the 'likely to become endangered' category, with a substantial minority (44%) falling in the 'not likely to become endangered' category. Although the BRT considered the significantly higher returns in recent years to be encouraging, most members felt that the factors responsible for the increases were more likely to be unusually favorable marine productivity conditions than improvements in freshwater productivity. The

majority of BRT members felt that to have a high degree of confidence that the species is healthy, high spawner escapements should be maintained for a number of years, and the freshwater habitat should demonstrate the capability of supporting high juvenile production from years of high spawner abundance.

Snake River (SR) Sockeye Salmon. SR sockeye salmon are unique. Anadromous sockeye salmon returning to Redfish Lake in Idaho's Stanley Basin travel a greater distance from the sea (approximately 900 miles) to a higher elevation (6,500 feet) than any other sockeye salmon population and are the southern-most population of sockeye salmon in the world (Bjornn *et al.* 1968; Foerster 1968). Stanley Basin sockeye salmon are separated by 700 or more river miles from two other extant upper Columbia River populations in the Wenatchee River and Okanogan River drainages. These latter populations return to lakes at substantially lower elevations (Wenatchee at 1870 feet, Okanagon at 912 feet) and occupy different ecoregions.

The only extant sockeye salmon population in the Snake River basin at the time of listing was that in Redfish Lake, in the Stanley Basin (upper Salmon River drainage) of Idaho. Other lakes in the Snake River basin historically supported sockeye salmon populations, including Wallowa Lake (Grande Ronde River drainage, Oregon), Payette Lake (Payette River drainage, Idaho) and Warm Lake (South Fork Salmon River drainage, Idaho) (Waples *et al.* 1997). These populations are now considered extinct. Although kokanee, a resident form of *Oncorhynchus nerka*, occur in numerous lakes in the Snake River basin, other lakes in the Stanley Basin and sympatrically with sockeye in Redfish Lake, resident *O.nerka* were not considered part of the species at the time of listing (1991). Subsequent to the 1991 listing a residual form of sockeye residing in Redfish Lake was identified. The residuals are non-anadromous, completing their entire life cycle in freshwater, but spawn at the same time and in the same location as anadromous sockeye salmon. In 1993, NMFS determined that residual sockeye salmon in Redfish Lake were part of the Snake River sockeye salmon. Also, artificially propagated sockeye salmon from the Redfish Lake Captive Propagation program are considered part of this species (70 FR 37160; June 28, 2005). NMFS has determined that this artificially propagated stock is genetically no more than moderately divergent from the natural population (NMFS 2005).

Five lakes in the Stanley Basin historically contained sockeye salmon: Alturas, Pettit, Redfish, Stanley and Yellowbelly (Bjornn *et al.* 1968). It is generally believed that adults were prevented from returning to the Sawtooth Valley from 1910 to 1934 by Sunbeam Dam. Sunbeam Dam was constructed on the Salmon River approximately 20 miles downstream of Redfish Lake. Whether or not Sunbeam Dam was a complete barrier to adult migration remains unknown. It has been hypothesized that some passage occurred while the dam was in place, allowing the Stanley Basin population or populations to persist (see Bjornn *et al.* 1968, Waples *et al.* 1991). Adult returns to Redfish Lake during the period 1954 through 1966 ranged from 11 to 4,361 fish (Bjornn *et al.* 1968). Sockeye salmon in Alturas Lake were extirpated in the early 1900s as a result of irrigation diversions, although residual sockeye may still exist in the lake (Chapman and Witty 1993). From 1955-1965, the Idaho Department of Fish and Game eradicated sockeye salmon from Pettit, Stanley, and Yellowbelly lakes, and built permanent structures on each of the lake outlets that prevented re-entry of anadromous sockeye salmon (Chapman and Witty 1993). In 1985, 1986 and 1987, 11, 29, and 16 sockeye, respectively, were counted at the Redfish Lake weir (Good *et al.* 2005). Only 18 natural origin sockeye salmon have returned to the Stanley

Basin since 1987. The first adult returns from the captive brood stock program returned to the Stanley Basin in 1999. From 1999 through 2005, a total of 345 captive brood program adults that had migrated to the ocean returned to the Stanley Basin.

Recent annual abundances of natural origin sockeye salmon in the Stanley Basin have been extremely low. No natural origin anadromous adults have returned since 1998 and the abundance of residual sockeye salmon in Redfish Lake is unknown. This species is entirely supported by adults produced through the captive propagation program at the present time. Current smolt-to-adult survival of sockeye originating from the Stanley Basin lakes is rarely greater than 0.3% (Hebdon *et al.* 2004). The current average productivity likely is substantially less than the productivity required for any population to be at low (1 to 5%) extinction risk at the minimum abundance threshold. The BRT determined that the SR sockeye salmon remains in danger of extinction (Good *et al.* 2005).

Limiting factors identified for SR sockeye include: (1) Reduced tributary stream flow, (2) impaired tributary passage and blocks to migration, and (3) mainstem Columbia River hydropower system mortality (NMFS 2005a).

Lower Columbia River (LCR) Steelhead. The status of LCR steelhead was initially reviewed by NMFS in 1996 (Busby *et al*. 1996), and the most recent review occurred in 1998 (NMFS 1998d). In the 1998 review, the BRT noted several concerns for this ESU, including the low abundance relative to historical levels, the universal and often drastic declines observed since the mid-1980s, and the widespread occurrence of hatchery fish in naturally-spawning steelhead populations. Analysis also suggested that introduced summer steelhead may negatively affect winter native winter steelhead in some populations. A majority of the 1998 BRT concluded that LCR steelhead were at risk of becoming endangered in the foreseeable future.

New data available for this update included: recent spawner data, additional data on the fraction of hatchery-origin spawners, recent harvest rates, updated hatchery release information, and a compilation of data on resident steelhead. New analyses for this update include the designation of demographically independent populations, recalculation of previous BRT metrics with additional years' data, estimates of median annual growth rate under different assumptions about the reproductive success of hatchery fish, and estimates of current and historically available kilometers of stream.

A large majority (over 79%) of the BRT votes for this species fell in the "likely to become endangered" category, with small minorities falling in the "danger of extinction" and "not likely to become endangered" categories. The BRT found moderate risks in all the VSP categories, with mean risk matrix scores ranging from moderately low for spatial structure to moderately high for both abundance and growth rate/productivity. All of the major risk factors identified by previous BRTs still remain. Most populations are at relatively low abundance, and those with adequate data for modeling are estimated to have a relatively high extinction probability.

Limiting factors identified for LCR steelhead include: (1) Degraded floodplain and stream channel structure and function, (2) reduced access to spawning/rearing habitat, (3) altered

streamflow in tributaries, (4) excessive sediment and elevated water temperatures in tributaries, and (5) hatchery impacts (NMFS 2005b).

Upper Willamette River (UWR) Steelhead. The status of UWR steelhead was reviewed in Busby *et al*. (1996) and updated in NMFS (1999). In the 1999 review, the BRT noted several concerns for this species, including the relatively low abundance and steep declines since 1988. The BRT was also concerned about the potential negative interaction between non-native summer steelhead and wild winter steelhead. The BRT considered the loss of access to historical spawning grounds because of dams to be a major risk factor. The 1999 BRT reached a unanimous decision that the UWR steelhead was at risk of becoming endangered in the foreseeable future.

New data considered in BRT (Good *et al.* 2005) for UWR steelhead include redd counts and dam/weir counts through 2000, 2001, or 2002, and estimates of hatchery fraction and harvest rates through 2000. New analyses for this update include the designation of demographically independent populations, and estimates of current and historically available kilometers of stream.

As part of its effort to develop viability criteria for UWR steelhead, the Willamette/Lower Columbia technical recovery team identified historically demographically-independent populations (Myers *et al*. 2002). Population boundaries are based on an application of VSP definition (McElhany *et al*. 2000). Myers *et al*. (2002) hypothesized that the species historically consisted of at least four populations (Mollala, North Santiam, South Santiam and Calapooia) and possibly a fifth (Coast Range). The historical existence of a population in the Coast Range is uncertain. The populations identified in Myers *et al*. (2002) are used as the units for the new analyses in Good *et al.* (2005).

Based on the updated information provided in the BRT report (Good *et al.* 2005), the information contained in previous UWR steelhead species status reviews, and preliminary analyses by the Willamette/Lower Columbia technical recovery team, a single population is self-sustaining could not be conclusively identified. All populations are relatively small, with the recent mean abundance of the entire species at less than 6,000. Over the period of the available time series, most of the populations are in decline. The recent elimination of the winter-run hatchery production will allow estimation of the natural productivity of the populations in the future, but the available time series are confounded by the presence of hatchery-origin spawners.

The majority (more than 76%) of the BRT votes for this species fell in the "likely to become endangered" category, with small minorities falling in the "danger of extinction" and "not likely to become endangered" categories. The BRT did not identify any extreme risks for this species but found moderate risks in all the VSP categories, ranging from moderately low for diversity to moderate spatial structure and growth rate/productivity. On a positive note, after a decade in which overall abundance (Willamette Falls count) hovered around the lowest levels on record, adult returns for 2001 and 2002, were up significantly, on par with levels seen in the 1980s. Still, the total abundance is low, and while recent increases are encouraging, it is uncertain whether they can be sustained. The BRT considered it a positive sign that releases of the *early* winter-run hatchery population have been discontinued, but remained concerned that releases of non-native summer-run steelhead continue.

Limiting factors identified for LCR steelhead include: (1) Reduced access to spawning/rearing habitat in tributaries, (2) altered water quality and temperature in tributaries, (3) altered stream flow in tributaries, and (4) lost/degraded floodplain connectivity and lowland stream habitat (NMFS 2005b).

Middle Columbia River (MCR) Steelhead. MCR steelhead include all naturally-spawned populations of steelhead in streams within the Columbia River basin from above the Wind River in Washington and the Hood River in Oregon (exclusive), upstream to, and including, the Yakima River in Washington, excluding steelhead from the Snake River basin (64 FR 14517, March 25, 1999). The major tributaries occupied by this species are the Deschutes, John Day, Klickitat, Umatilla, Walla Walla, and Yakima river systems. The John Day River represents the largest naturally spawning, native stock of steelhead in the region. MCR steelhead do not include resident forms of *O.mykiss* (rainbow trout) co-occurring with these steelhead.

The ICBTRT (2003) identified 15 populations in four major population groups (Cascades Eastern Slopes Tributaries, John Day River, the Walla Walla and Umatilla rivers, and the Yakima River) and one unaffiliated independent population (Rock Creek) in this species. There are two extinct populations in the Cascades Eastern Slope major population group (MPG), the White Salmon River and Deschutes River above Pelton Dam.

MCR steelhead remain well-distributed in the majority of occupied subbasins. However, natural returns to the Yakima River, once a major historical production center for the species, continue to be less than 20% of the interim recovery abundance target for the subbasin (Good *et al.* 2005). The presence of substantial numbers of out-of-basin (and largely out-of-species) natural spawners in the Deschutes River raised substantial concern within the NMFS BRT regarding the genetic integrity and productivity of the native Deschutes population.

The five-year average return (geometric mean) of natural MCR steelhead for 1997-2001 was up from previous years' basin estimates (Good *et al.* 2005). Returns to the Yakima River, the Deschutes River and sections of the John Day River system were substantially higher compared to 1992-1997 (Good *et al.* 2005). Yakima River returns are still substantially below interim target levels and estimated historical return levels, with the majority of spawning occurring in one tributary, Satus Creek (Berg 2001). Recent 5-year geometric mean annual returns to the John Day basin are generally below the corresponding mean returns reported in previous status reviews. However, each major production area in the John Day system has shown upward trends since the 1999 return year (Good *et al.* 2005).

Thus, despite recent increases in MCR steelhead returns, the BRT believes that the species remains at moderate risk for all four VSP parameters. Consequently the BRT has determined that MCR steelhead remain likely to become endangered (Good *et al.* 2005).

Liming factors identified for MCR steelhead include: (1) Hydropower system mortality at mainstem Columbia River dams, (2) reduced stream flow in tributaries, (3) impaired passage in tributaries, (4) excessive fine sediment in stream substrates, (5) degraded water quality, and (6) altered channel morphology (NMFS 2005b).

Upper Columbia River (UCR) Steelhead The 1998 steelhead status review identified a number of concerns for UCR steelhead. While the total abundance of populations within this species has been relatively stable or increasing, it appears to be occurring only because of major hatchery supplementation programs. The major concern for this species is the failure of natural stocks to replace themselves. The previous BRT members were also strongly concerned about the problems of genetic homogenization due to hatchery supplementation, apparent high harvest rates on steelhead smolts in rainbow trout fisheries and the degradation of freshwater habitats within the region, especially the effects of grazing, irrigation diversions and hydroelectric dams.

A slight majority (54%) of the BRT votes for this species fell in the "danger of extinction" category, with most of the rest falling in the "likely to become endangered" category. The most serious risk identified was growth rate/productivity, estimated to be high to very high; other VSP factors were also relatively high, ranging from moderate for spatial structure to moderately high for diversity. The last 2 to 3 years have seen an encouraging increase in the number of naturally-produced fish. However, the recent mean abundance in the major basins is still only a fraction of interim recovery targets. Furthermore, overall adult returns are still dominated by hatchery fish, and detailed information is lacking regarding productivity of natural populations. The ratio of naturally-produced adults to parental spawners (including hatchery fish) remains low for UCR steelhead. The BRT did not find data to suggest that the extremely low replacement rate of naturally-spawning fish (estimated adult:adult ratio was only 0.25-0.3 at the time of the last status review update) has improved substantially.

Liming factors identified for the UCR steelhead include: (1) Mainstem Columbia River hydropower system mortality; (2) reduced tributary streamflow; (3) tributary riparian degradation and loss of in-river wood; (4) altered tributary floodplain and channel morphology; and (5) excessive fine sediment and degraded tributary water quality (NMFS 2005b).

Snake River Basin (SRB) Steelhead. The SRB steelhead species includes all naturally-spawned populations of steelhead (and their progeny) in streams in the Snake River basin of southeast Washington, northeast Oregon, and Idaho (62 FR 43937; August 18, 1997). SRB steelhead do not include resident forms of *O.mykiss* (rainbow trout) co-occurring with these steelhead.

The ICBTRT (2003) identified 23 populations in the following six major population groups (MPGs) in this species: Clearwater River, Grande Ronde River, Hells Canyon, Imnaha River, Lower Snake River, and Salmon River. The BRT noted that SRB steelhead remain spatially well distributed in each of the six major geographic areas in the Snake River basin (Good *et al.* 2005). Environmental conditions are generally drier and warmer in these areas than in areas occupied by other steelhead species in the Pacific Northwest. SRB steelhead were blocked from portions of the upper Snake River beginning in the late 1800s and culminating with the construction of Hells Canyon Dam in the 1960s.

Sexually immature adult SRB steelhead return to the Columbia River between late June and October. They are considered a summer run and are known as a stream-maturing type. SRB steelhead returns consist of A-run fish that spend one year in the ocean, and larger B-run fish that spend two years at sea. Adults typically migrate upriver until they reach tributaries from 1,000

to 2,000 meters above sea level where they spawn between March and May of the following year. Unlike other anadromous members of the *Oncorhynchus* genus, some adult steelhead survive spawning, return to the sea, and later return to spawn a second time. After hatching, juvenile SRB steelhead typically spend 2 to 3 years in fresh water before they smolt and migrate to the ocean. The SRB steelhead "B run" population levels remain particularly depressed.

The paucity of information on adult spawning escapement for specific tributary production areas for SRB steelhead made a quantitative assessment of viability difficult. 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 return over Lower Granite Dam was substantially higher relative to the low levels seen in the 1990s; the recent 5-year mean abundance (14,768 natural returns) was approximately 28% of the interim recovery target level. The abundance surveyed in sections of the Grande Ronde, Imnaha and Tucannon rivers improved in 2001. However, recent 5-year abundance and productivity trends (through 2001) 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 (through 2001) were marginally above replacement or well below replacement, depending upon the assumption made regarding the effectiveness of hatchery fish in contributing to natural production.

Cooney (2004) reported continuing high returns of natural-origin SRB steelhead (both A- and B-run fish) during 2002 and 2003 compared to those observed during much of the 1990s. In their preliminary report, Fisher and Hinrichsen (2004) estimated that the geometric mean of the natural-origin run was 37,784 during 2001-2003, a 253% increase over the 1996-2000 period (10,694 steelhead). The slope of the population trend increased 9.3% (from 1.00 to 1.10) when the counts for 2001-2003 were added to the 1990-2000 data series. These data indicate that, at least in the short term, the natural-origin run has been increasing. Despite the recent increases in SRB steelhead returns, the BRT believes that the species remains at moderate risk for abundance, productivity, and diversity. Consequently, the BRT has determined that SRB steelhead remains likely to become endangered (Good *et al.* 2005).

The BRT was also concerned about the predominance of hatchery-origin fish in this species, the inferred displacement of naturally produced fish by hatchery-origin fish, and potential impacts on species diversity. High straying rates exhibited by some hatchery programs generated concern about the possible homogenization of population structure and diversity. However, recent efforts to improve the use of local broodstock and release of hatchery fish away from natural production areas are encouraging.

Limiting factors identified for SRB steelhead include: (1) Lower Snake and Columbia rivers hydrosystem mortality, (2) reduced tributary streamflow, (3) altered tributary channel morphology, (4) excessive fine sediment in tributaries, (5) degraded tributary water quality, and (6) harvest- and hatchery-related adverse effects (NMFS 2005b).

Puget Sound Steelhead. Puget Sound steelhead occupy river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington. Included are river basins as far west as the

Elwha River and as far north as the Nooksack River. Puget Sound's fjord-like structure may affect steelhead migration patterns; for example, some populations of coho and Chinook salmon, at least historically, remained within Puget Sound and did not migrate to the Pacific Ocean itself. Even when Puget Sound steelhead migrate to the high seas, they may spend considerable time as juveniles or adults in the protected marine environment of Puget Sound, a feature not readily accessible to steelhead from other areas of the Pacific Northwest (Puget Sound Steelhead BRT 2005). This species 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.

NMFS convened a BRT to review the status of Puget Sound steelhead in July, 2005. The overwhelming majority of the BRT concluded that Puget Sound steelhead is ''likely to become endangered within the foreseeable future throughout all or a significant portion of its range.'' The BRT noted that the risk of declining abundance to this species viability is high. Because of the BRT's conclusion that virtually all hatchery summer- and winter-run steelhead populations in Puget Sound should be considered to be excluded from the species, the BRT focused its attention where possible on abundance of naturally produced fish. Trends in escapement and run size of natural steelhead were predominantly downward throughout much of the species range, over both longer-term (since about 1980 for most systems) and shorter-term (since the mid 1990s) time series. For several populations, the shorter-term trends are even more sharply negative than the longer-term trends that incorporate large abundance estimates for several populations in the early 1980s.

The BRT also noted that that declining productivity poses a high risk to this species' viability. Natural run sizes (sum of harvest and escapement) for most populations show even more marked declining trends than indicated by escapements, indicating that the substantially reduced harvest rates for natural fish since the early 1990s have not resulted in a rebound in steelhead production in Puget Sound. Estimates of the mean number of recruits per spawner are less than 1.0 in several systems, as are long-term population growth rates.

The BRT found a moderate risk for diversity, and expressed concern over the status of the summer-run populations of steelhead in the species. Populations of summer-run steelhead occur throughout Puget Sound but are concentrated in northern Puget Sound area, are generally small, and are characterized as isolated populations adapted to streams with distinct attributes. For the one summer-run population that has associated natural escapement and run size data, the BRT observed that the trend in abundance was predominantly negative. Concerns over hatchery practices in this area persist, as annual releases of hatchery steelhead smolts derived from non-local populations (Skamania summer-run steelhead) or from domesticated populations originally founded within this species (Chambers Creek winter-run steelhead) persist in most systems, and several of these releases are still composed of tens or hundreds of thousands of fish. This sustained hatchery management practice has elevated opportunities for interbreeding and ecological interaction between wild and hatchery fish, in spite of the apparent differences in average spawning time, and its associated adverse fitness consequences for both summer- and winter-run steelhead.

The BRT found moderate risk for this species' spatial structure. A strong majority of BRT members concluded that the species is likely to be at elevated risk due to reduced complexity of spatial structure of its steelhead populations and, consequently, diminishing connectivity among them. Several members felt that the declines in natural abundance for most populations, coupled with large numbers of anthropogenic barriers such as impassable culverts, sharply reduce opportunities for natural adfluvial movement and migration between steelhead aggregations in different watersheds.

Habitat utilization by steelhead in the Puget Sound area has been dramatically affected by large dams and other manmade barriers in a number of river basins: the Nooksack, Skagit, White, Nisqually, Skokomish, and Elwha river basins. Several of these dams have eliminated access to historical habitats, while others are located above historically impassable natural barriers. Many upper tributaries in the Puget Sound region have been affected by poor forestry practices, while many of the lower reaches of rivers and their tributaries have been altered by agriculture and urban development. Urbanization has caused direct loss of riparian vegetation and soils, significantly altered hydrologic and erosional rates and processes (by creating impermeable surfaces such as roads, buildings, parking lots, sidewalks *etc.*), and polluted waterways with stormwater and point-source discharges. The loss of wetland and riparian habitat has dramatically changed the hydrology of many streams. Land development for agricultural purposes has also altered the historical land cover, and as much of this development has occurred in river floodplains, there has been a direct impact on river flow levels and morphology. River braiding and sinuosity have been reduced through the construction of dikes, hardening of banks with riprap, and channelization. Constriction of river flows, particularly during high flow events, increases the likelihood of gravel scour and the dislocation of rearing juveniles. The loss of side-channel habitats has also reduced important areas for spawning, juvenile rearing, and overwintering habitats. Estuarine areas have been dredged and filled, resulting in the loss of important juvenile rearing areas.

Extensive artificial propagation has historically supported high levels of steelhead harvest in the Puget Sound area. The majority of harvest occurred in recreational fisheries, but tribal fisheries directed at steelhead are also important. Prior to the promulgation of regulations by WDFW in the mid 1990s protecting all wild steelhead from recreational fishery harvest, Puget Sound steelhead fisheries likely contributed to the present decline in abundance of natural steelhead populations. Existing steelhead recreational fisheries in Puget Sound, while appropriately minimizing potential adverse impacts on natural steelhead populations, may still result in a continued mortality of early-returning natural steelhead through poaching and hook-and-release mortalities.

Southern DPS green sturgeon. Green sturgeon is a widely-distributed and marine-oriented species found in nearshore waters from Baja California to Canada (NMFS 2008). There are two DPSs defined for green sturgeon – a northern DPS with spawning populations in the Klamath and Rogue rivers and a southern DPS that spawns in the Sacramento River (NMFS 2008). The southern DPS includes all spawning populations of green sturgeon south of the Eel River in California, of which only the Sacramento River currently contains a spawning population. McLain (2006) noted that Southern DPS green sturgeon were first determined to

occur in Oregon and Washington waters in the late 1950s when tagged San Pablo Bay green sturgeon were recovered in the Columbia River estuary (CDFG 2002).

The green sturgeon BRT convened a status review update in November 2004 (Sturgeon BRT 2005). The majority of the BRT concluded that in the southern green sturgeon DPS is likely to become endangered in the foreseeable future and only one member concluded that the southern DPS is not in danger of extinction or likely to become endangered in the foreseeable future. Weighing heavily in this decision was the fact that only one population of spawning adults (Sacramento River) remains. The BRT felt that the blockage of green sturgeon spawning from what were certainly historic spawning areas above Shasta Dam and the accompanying decrease in spawning area with the loss of the Feather River spawning area make green sturgeon in the southern DPS at risk of extinction in the foreseeable future.

Green sturgeon estuarine/marine distribution and the seasonality of estuarine use range-wide are largely unknown. Southern DPS green sturgeon are known to congregate in coastal waters and estuaries, including non-natal estuaries, such as the Rogue River. Beamis and Kynard (1997) suggested that green sturgeon move into estuaries of non-natal rivers to feed. Information from fisheries-dependent sampling suggests that green sturgeon only occupy large estuaries during the summer and early fall in the northwestern United States. Green sturgeon are known to enter Washington estuaries during summer (Moser and Lindley 2007). Commercial catches of green sturgeon peak in October in the Columbia River estuary, and records from other estuarine fisheries (Willapa Bay and Grays Harbor, Washington) support the idea that sturgeon are only present in these estuaries from June until October (Moser and Lindley 2007).

Status of Critical Habitat. The ESA requires the federal government to designate critical habitat for any species it lists under the ESA; in this case, salmon and steelhead. Critical habitat is defined as: (1) Specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and whether those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation.

The species addressed by this consultation have had critical habitat designated between 1993 and 2008 (refer to Table 6). Three species, LCR coho salmon, PS steelhead, and Southern DPS green sturgeon, do not have designated critical habitat.

To assist in the designation of critical habitat in 2005, NMFS convened several Critical Habitat Analytical Review Teams (CHARTs) organized by major geographic areas that roughly correspond to salmon recovery planning domains. The CHARTs consisted of Federal biologists and habitat specialists from NMFS, the U.S. Fish and Wildlife Service, FS, and BLM, with demonstrated expertise regarding salmonid habitat and related protective efforts within the domain.

The CHARTs were tasked with assessing biological information pertaining to areas under consideration for designation as critical habitat. Specifically, CHARTs: (1) Determined if occupied areas contained PCEs essential for conservation; (2) determined whether there were

any unoccupied areas within the historical range of the listed salmon and steelhead that may be essential for conservation; (3) scored each habitat area based on several factors related to the quantity and quality of the physical and biological features; (4) rated each habitat area as having a ''high,'' ''medium,'' or ''low'' conservation value; and (5) identified management actions that could affect salmonid habitat in given areas.[6]

The ESA gives the Secretary of Commerce discretion to exclude areas from designation if he determines that the benefits of exclusion outweigh the benefits of designation. Considering economic factors and information from CHARTs, NMFS excluded areas in the following categories during its 2005 critical habitat designations[7]:

1. Military areas. All military areas were excluded because of the current national priority on military readiness, and in recognition of conservation activities covered by military integrated natural resource management plans.
2. Tribal lands. Native American lands were excluded because of the unique trust relationship between tribes and the federal government, the federal emphasis on respect for tribal sovereignty and self governance, and the importance of tribal participation in numerous activities aimed at conserving salmon.
3. Habitat Conservation Plans. Some lands covered by habitat conservation plans were excluded because NMFS had evidence that exclusion would benefit our relationship with the landowner, the protections secured through these plans outweigh the protections that are likely through critical habitat designation, and exclusion of these lands may provide an incentive for other landowners to seek similar voluntary conservation plans.
4. Economic Impacts. NMFS excluded areas where the conservation benefit to the species is relatively low compared to the economic impacts.

When NMFS designated critical habitat in 2005 for the salmon and steelhead considered in this consultation, NMFS used the watershed or 5th field hydrologic unit code (HUC) to organize critical habitat information systematically and at a scale that is applicable to the spatial distribution of salmon. Organizing information at this scale is especially relevant to salmonids, since their innate homing ability allows them to return to the watersheds where they were born. Such site fidelity results in spatial aggregations of salmonid populations that generally correspond to the area encompassed by 5th field watersheds (Washington Department of Fisheries *et al.*, 1992; Kostow, 1995; McElhany *et al.*, 2000). For prior critical habitat designations, spatial data for 5th field watersheds was widely not available, and NMFS used the subbasin or 4th field HUC to organize critical habitat information. Older critical habitat for SR sockeye, SR fall-run Chinook salmon, and SR spring/summer run Chinook salmon was designated at the 4th field subbasin scale.

[6] CHART reports are available at: http://www.nwr.noaa.gov/Salmon-Habitat/Critical-Habitat/2005-Biological-Teams-Report.cfm

[7] More detailed information on the 2005 critical habitat designations, including exclusions, is available at: http://www.nwr.noaa.gov/Publications/FR-Notices/2005/upload/70FR52630Pre.pdf

The NMFS reviews the status of designated critical habitat affected by the proposed action by examining the condition and trends of primary constituent elements (PCEs) throughout the designated area. PCEs consist of the physical and biological features identified as essential to the conservation of the listed species in the documents that designate critical habitat (Tables 8 and 9).

Table 8. Types of sites and essential physical and biological features named as PCEs in all salmon and steelhead critical habitat designations, except SR spring/ summer run Chinook salmon, SR fall-run Chinook salmon, and SR sockeye salmon (Table 8).

Site	Essential Physical and Biological Features	Species Life Stage
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity and floodplain connectivity	Juvenile growth and mobility
	Water quality and forage	Juvenile development
	Natural cover [a]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[a]	Juvenile and adult mobility and survival
Estuarine areas	Free of obstruction, water quality and quantity, and salinity	Juvenile and adult physiological transitions between salt and freshwater
	Natural cover,[a] forage,[b] and water quantity	Growth and maturation
Nearshore marine areas	Free of obstruction, water quality and quantity, natural cover,[a] and forage [b]	Growth and maturation, survival
Offshore marine areas	Water quality and forage [b]	Growth and maturation

[a] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.

Table 9. Types of sites and essential physical and biological features designated as PCEs, for SR spring/summer run Chinook salmon, SR fall-run Chinook salmon, and SR sockeye salmon (Table 9).

Habitat Component	Spring/Summer run Chinook salmon	Fall-run Chinook salmon	Sockeye salmon
Spawning and juvenile rearing areas	Spawning gravel Water quality Water quantity Cover/shelter Food Riparian vegetation Space	Same as Spring/summer run Chinook	Spawning gravel Water quality Water quantity Water temperature Food Riparian vegetation Access
Juvenile migration corridors	Substrate Water quality Water quantity Water temperature Water velocity Cover/shelter Food Riparian vegetation Space Safe passage	Same as Spring/summer run Chinook	Same as Spring/summer run Chinook
Areas for growth and development to adulthood	Ocean areas – not identified	Same as Spring/ summer run Chinook	Same as Spring/ summer run Chinook
Adult migration corridors	Substrate Water quality Water quantity Water temperature Water velocity Cover/shelter Riparian vegetation Space Safe passage	Same as Spring/ summer run Chinook	Same as Spring/ summer run Chinook

Status of Critical Habitat in the Lower Columbia and Willamette River Basins. Critical habitat has been designated in the Lower Columbia and Willamette River basins for UWR spring Chinook salmon, LCR Chinook salmon, LCR steelhead, UWR steelhead, and CR chum salmon.

The Willamette River, once a highly braided river system, has been dramatically simplified through channelization, dredging, and other activities that have reduced rearing habitat by as much as 75%. In addition, the construction of 37 dams in the basin has blocked access to more than 435 miles of stream and river spawning habitat. The dams alter the temperature regime of the Willamette and its tributaries, affecting the timing and development of naturally-spawned eggs and fry. Water quality is also affected by development and other economic activities. Agricultural and urban land uses on the valley floor and timber harvesting in the Cascade and Coast ranges contribute to increased erosion and sediment load in Willamette River basin streams and rivers. Municipal and industrial pollution has been present in the Lower Willamette River since the 1920s. Gravel mining has considerable effects on substrate quantity and quality in the Upper Willamette River.

The mainstem Willamette River has been altered by historical channelization and large wood removal. Extensive agricultural and urban development reduced the riparian forest beginning in the 1870s (Sedell and Froggatt 1984). Gregory *et al.* (2002b) calculated that the total mainstem Willamette River channel area decreased from 41,000 to 23,000 acres between 1895 and 1995. They noted that the lower reach, from the mouth of the river to Newberg (RM 50), is confined within a basaltic trench, and that due to this geomorphic constraint, less channel area has been lost than in upstream areas. The middle reach from Newberg to Albany (RM 50 to RM 120), which encompasses the proposed mining site, has incurred losses of 12% primary channel area, 16% side channels, 33% alcoves, and 9% islands. Overall, the length of channel types did not change while the area declined. The greatest changes were in the upper reach, from Albany to Eugene (RM 187). In this reach, approximately 40% of both channel length and channel area were lost, as well as 21% primary channel, 41% side channel, 74% alcoves, and 80% island areas.

The banks of the Willamette River have more than 96 miles of revetments; approximately half constructed by the Army Corps of Engineers. Generally, the revetments were placed in the vicinity of roads or on the outside bank of river bends, so that while only 26% of the total length is revetted, 65% of the meander bends are revetted (Gregory *et al*. 2002c). The majority of dynamic sections have been armored, reducing adjustments in channel bed and sediment storage by the river, which diminishes both the complexity and abundance of aquatic habitats (Gregory *et al.* 2002b).

Overall, riparian forests have diminished considerably in the lower reaches of the Willamette River (Gregory *et al.* 2002c). Sedell and Frogatt (1984) noted that agriculture and cutting of streamside trees were major agents of change for riparian vegetation, along with snagging of large wood in the channel. The reduced shoreline, fewer and smaller snags, and reduced riparian forest comprise large functional losses to the river, reducing structural features, organic inputs from litter fall, entrained allochthonous materials, and flood flow filtering capacity. Extensive changes began before the major dams were built, as the navigational and agricultural demands dominated the early use of the river. The once expansive forests of the Willamette River floodplain provided valuable nutrients and organic matter during flood pulses, food sources for macroinvertebrates, and slow-water refugia for fish during flood events. These forests also cooled river temperatures as the river flowed through its many channels.

Gregory *et al.* (2002c) described the changes in riparian vegetation in river reaches from the mouth to Newberg, from Newberg to Albany, and from Albany to Eugene. They noted that the riparian forests were formerly a mosaic of brush, marsh, and ash openings maintained by annual flood inundation. Below the City of Newberg, the most noticeable change was that conifers were almost eliminated. Above Newberg, the formerly hardwood-dominated riparian forests along with mixed forest made up less than half of the riparian vegetation by 1990, while agriculture dominated. This conversion represents a loss of recruitment of LWD, which functions as a component of channel complexity, much as the morphology of the streambed does, to reduce velocity and provide habitat for invertebrates that support the salmonid prey food base. Declining extent and quality of riparian forests have also reduced rearing and refugia habitat provided by large wood, shading by riparian vegetation which can cool water temperatures, and the availability of leaf litter and the macroinvertebrates that feed on it.

Hyporheic flow in the Willamette River has been examined through discharge measurements and was found to be significant in some areas, particularly those with gravel deposits (Fernald *et al.* 2001). The loss of channel complexity and meandering that fosters creations of gravel deposits decreases the potential for hyporheic flows, as does gravel mining. Hyporheic flow processes water and affects its quality on re-emerging into the main channel, stabilizing variations in physical and chemical water characteristics. Hyporheic exchange was found to be significant when USGS examined evidence for the National Water-Quality Assessment of the Willamette Basin (Wentz *et al.* 1998). In the transient storage zone, hyporheic flow is important for ecological functions and water quality features such as dissolved oxygen and some benthic invertebrate life stages. Alcove habitat, limited by channelization, combines low hydraulic stress and high food availability with the potential for hyporheic flows across the steep hydraulic gradients in the gravel separating them from the main channel (Fernald *et al.* 2001).

Several hydropower projects including the Bonneville Dam on the mainstem Columbia River adversely affect habitat along the Lower Columbia River. The series of dams along the Columbia River blocked an estimated 12 million cubic yards of debris and sediment that would otherwise naturally flow down the Columbia, replenishing the shorelines along the Washington and Oregon coasts.

Industrial harbor and port development have been significant along the mainstem Columbia River. One hundred miles of river channel within the mainstem Columbia River, its estuary, and Oregon's Willamette River have been dredged as a navigation channel by the Army Corps of Engineers since 1878. Originally dredged to a 20-foot minimum depth in 1878, the Federal navigation channel of the Lower Columbia River is now maintained at a depth of 43 feet and a width of 600 feet.

The Lower Columbia River supports five ports on the Washington State side: Kalama, Longview, Skamania County, Woodland, and Vancouver. These ports primarily focus on the transport of timber and agricultural commodities. In addition to loss of riparian habitat, and disruption of benthic habitat due to dredging, several sediment chemical exceedances, such as arsenic and polycyclic aromatic hydrocarbons (PAHs), have been identified in Lower Columbia River watersheds in the vicinity of the ports and associated industrial activities.

The most extensive urban development in the Lower Columbia River watershed occurs in the Vancouver/Camas area. Outside of this major urban area, the majority of residential development relies on septic systems. Common water contaminants associated with urban development and residential septic systems include excessive water temperatures, lowered dissolved oxygen levels, increased fecal coliform bacteria, and increased chemicals associated with pesticides and urban runoff.

In addition to the hydropower development in the Columbia River, complex freshwater and estuarine habitats needed to maintain diverse wild populations and life histories have been lost and fragmented, increasing the risk of extinction for salmon stocks in the Columbia River basin. Freshwater rearing sites and migration corridors for juvenile salmonids are PCEs of critical habitat. Not only have rearing habitats been removed or altered within the Lower Columbia River, but the connections among habitats needed to support tidal and seasonal movements of

juvenile salmon have been severed. The most significant habitat changes in the Columbia River estuary have been the loss of tidal marsh and tidal swamp habitat that are critical to juvenile salmonids, particularly small or ocean-type salmonids (Johnson *et al.* 2003; Thomas 1983; USACOE 2001). The edges of marsh areas provide sheltered habitats for juvenile salmon where food in the form of amphipods or other small invertebrates which feed on marsh detritus is plentiful and larger predatory fish is avoided (Seaman 1977).

Historically, floodwaters of the Columbia River inundated the margins and floodplains along the estuary, allowing juvenile salmon access to a wide expanse of low-velocity marshland and tidal channel habitats (Bottom *et al.* 2001). In general, the riverbanks were gently sloping, with riparian and wetland vegetation at the higher elevations of the river floodplain becoming salmonid habitat during flooding river discharges or flood tides. Sherwood *et al.* (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats between 1870 and 1970. This study further estimated an 80% reduction in emergent vegetation production and a 15% decline in benthic algal production.

Altered channel morphology and stability, lost/degraded floodplain connectivity are significant limiting factors in the Willamette and Lower Columbia rivers and their tributaries. Other major factors affecting critical habitat PCEs are loss of habitat diversity, excessive sediment, degraded water quality and increased stream temperatures. Reduced stream flows and fish passage blockages have reduced access to spawning and rearing areas (NMFS 2005b).

Status of Critical Habitat in the Interior Columbia Basin. Critical habitat has been designated in the Interior Columbia Basin (including the Snake River basin) for SR spring/summer run Chinook salmon, SR fall-run Chinook salmon, UCR spring-run Chinook salmon, SR sockeye salmon, MCR steelhead, UCR steelhead, and SRB steelhead. Major tributary river basins in the Interior Columbia Basin include the Klickitat, Deschutes, Yakima, John Day, Umatilla, Walla Walla, Methow, Entiat, Wenatchee, Grande Ronde, Tucannon, Imnaha, Clearwater, and Salmon.

Migratory habitat quality in this area has been severely affected by the development and operation of the Federal Columbia River Power System (FCRPS) dams in the mainstem Columbia River and privately owned dams in the Snake and Upper Columbia river basins. Hydroelectric development has modified natural flow regimes, resulting in higher water temperatures, changes in fish community structure leading to increased rates of piscivorous and avian predation on juvenile salmonids, and delayed migration time for both adult and juvenile salmonids. Physical features of dams such as turbines also kill migrating fish. In-river survival is inversely related to the number of hydropower projects encountered by emigrating juveniles. Construction of Hells Canyon Dam eliminated access to several likely production areas in Oregon and Idaho including the Burnt, Powder, Weiser, Payette, Malheur, Owyhee, and Boise river basins (Good *et al.* 2005). Grande Coulee and Chief Joseph dams on the Upper Columbia River completely block anadromous fish passage on the upper mainstem Columbia River.

In addition to the development and operation of the dams in the mainstem rivers, development and operation of extensive irrigation systems and hydroelectric dams for water withdrawal and

storage in tributaries have drastically altered hydrological cycles, causing a variety of adverse impacts to salmon and steelhead spawning and rearing habitat. A series of large regulating dams on the middle and upper Deschutes River impact flow, block access to upstream habitat, and have extirpated one or more populations from the Cascades Eastern Slope MPG (ICBTRT 2003). Pelton Round Butte Dam, for instance, blocked 32 miles of MCR steelhead habitat in the mainstem Deschutes below Big Falls, and removed the historically important tributaries of the Metolius River and Squaw Creek from production. Similarly, Condit Dam on the White Salmon River has extirpated another population from the Cascades Eastern Slope MPG. In the Umatilla subbasin, the Bureau of Reclamation developed the Umatilla Project in 1906, effectively eliminating over 108 miles of historically highly productive tributary habitat for MCR steelhead in upper McKay Creek due to construction of the McKay Dam and Reservoir in 1927. A flood control and irrigation dam on Willow Creek was also built near river mile 5, completely blocking MCR steelhead access to productive habitat upstream in this subbasin. Construction of Lewiston Dam, completed in 1927, eliminated access for Snake River basin steelhead and salmon to a major portion of the Clearwater basin.

Habitat quality in tributary streams in the Interior Columbia Basin varies from excellent in wilderness and roadless areas to poor in areas subject to heavy agricultural and urban development (Overton *et al.* 1995; Wissmar *et al.* 1994; and McIntosh *et al.* 1994). Lack of summer stream flows, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in developed areas. Critical habitat throughout the Interior Columbia River basin has been degraded by several management activities, including intense agriculture, alteration of stream morphology (*i.e.*, channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, timber harvest, mining, and urbanization (Lee *et al.* 1997). Changes in habitat quantity, availability, and diversity, and flow, temperature, sediment load and channel instability are common symptoms of ecosystem decline in areas of critical habitat.

Many stream reaches designated as critical habitat in the Interior Columbia Basin are over-allocated under state water law, with more allocated water rights than existing streamflow conditions can support. Irrigated agriculture is common throughout this region and withdrawal of water increases summer stream temperatures, blocks fish migration, strands fish, and alters sediment transport (Spence *et al.* 1996). Continued operation and maintenance of large water reclamation systems such as the Umatilla Basin and Yakima Projects have disrupted the entire riverine ecosystem. Reduced tributary stream flow has been identified as a major limiting factor for all listed salmon and steelhead species in this area except SR fall-run Chinook salmon (NMFS 2005b).

Impaired water quality is a problem in many tributaries of the Columbia and Snake rivers. Summer stream temperature is the primary water quality problem for this area, with many stream reaches designated as critical habitat listed on the Clean Water Act (CWA) 303(d) list for water temperature. Many areas that were historically suitable rearing and spawning habitat are now unsuitable due to high summer stream temperatures. Removal of riparian vegetation, alteration of natural stream morphology, and withdrawal of water for agricultural or municipal use all contribute to elevate stream temperatures. Contaminants such as insecticides and herbicides

from agricultural runoff and heavy metals from mine waste are common in some areas of critical habitat.

Status of Critical Habitat in the Southern Oregon Coastal Basins. Critical habitat has been designated for SONCC coho salmon in streams in southwest Oregon such as the Rogue, Chetco, and Elk rivers. Other rivers in the Oregon Coastal basin, such as the Siuslaw and Umpqua, are not occupied by listed salmon and steelhead and do not have critical habitat designated for anadromous salmonids. The following summarizes the status of critical habitat in the Rogue, Chetco, and Elk river basins, and other smaller basins within this area have similar habitat characteristics and limiting factors.

The Rogue River drains approximately 5,160 square miles within Curry, Jackson and Josephine counties in southwest Oregon. The mainstem is about 200 miles long and traverses the coastal mountain range into the Cascades. The Rogue River estuary has been modified from its historical condition. Jetties were erected by the Corps of Engineers in 1960, which stabilized and deepened the mouth of the river. A dike was completed in 1973 that extends from the south shore near Highway 101 to the south jetty. This dike created a backwater for the large shallow area that existed here, which has been developed into a boat basin and marina, eliminating most of the tidal marsh function.

The quantity of estuary habitat is naturally limited in the Rogue River. The Rogue River has a drainage area of 5,160 square miles, but the estuary is one of the smallest in Oregon at 1,880 acres. Between 1960 and 1972, approximately 13 acres of intertidal and 14 acres of subtidal land was filled in to build the boat basin dike, the marina, north shore riprap and the other north shore developments (Hicks 2005). Jetties constructed in 1960 to stabilize the mouth of the river and prevent shoaling have altered the Rogue River, which historically formed a sill during summer months (Hicks 2005).

The Lower Rogue Watershed Council's watershed analysis (Hicks 2005) lists factors limiting fish production in tributaries to Lower Rogue River watershed. The list includes water temperatures, low stream flows, riparian forest conditions, fish passage and overwintering habitat. Limiting factors identified for the Upper Rogue River Basin include: fish passage barriers, high water temperatures, water quantity, lack of large woody debris, low habitat complexity, and high fine sediment levels (Rogue Basin Coordinating Council 2006)

The Chetco River is in the southwest corner of Oregon, almost entirely within Curry County, with a drainage of approximately 352 square miles. The Chetco River mainstem is about 56 miles long, and the upper 28 miles are within the Kalmiopsis Wilderness. Elevations in the watershed range from sea level to approximately 5,098 feet on Pearsoll Peak. The upper portion of the basin is characterized by steep, sloping forested areas with narrow valleys and tributary streams that have moderately steep to very steep gradient. The lowest 11 miles of the river are bordered by private land in rural/residential, forestry, and urban land uses.

The Chetco River estuary has been significantly modified from its historical condition. Jetties were erected by the Corps of Engineers in 1957, which stabilized and deepened the mouth of the river. These jetties have greatly altered the mouth of the Chetco River and how the estuary

functions as habitat for salmon migrating to the ocean. A boat basin and marina were built in the late 1950s and eliminated most of the functional tidal marsh. The structures eliminated shallow water habitats and vegetation in favor of banks stabilized with riprap. Since then, nearly all of the remaining the streambanks of the estuary have been stabilized with riprap. The South Coast Watershed Council's watershed analysis (Maguire 2001) states the limiting factors to fish production in the Chetco River appear to be water temperature (due to reduced shade, especially in tributaries), fine sediment transport and storage (due to roads in tributary watersheds), number of roads, and estuary habitat. The amount and quality of overwintering habitat is poor due to a lack of large woody debris in tributaries and the mainstem (Maguire 2001a). Sedimentation and the number of roads are also listed by Maguire (2001a) as limiting factors.

The Elk River is located primarily in Curry County, and drains approximately 92 square miles or 58,678 acres (Maguire 2001b). Major tributaries of the Elk River include the North Fork, South Fork, Blackberry Creek, Panther Creek, Butler Creek, and Bald Mountain Creek. The upper portion of the Elk River basin is characterized by steeply sloped forested areas with narrow valleys and tributary streams that have steep to very steep gradients. Grazing, rural residential development and other agricultural uses are the dominant land uses in the lower portion of the basin (Maguire 2001b). Over one half of the Elk River basin is situated in the Grassy Knob wilderness area. Historic logging, mining, and road building have degraded stream and riparian habitats in the Elk River basin. Limiting factors identified for salmonid production in this basin include weak riparian cover (especially in the lower sections), fine sediment sources (present and potential), high water temperatures, and noxious weed invasions (Maguire 2001b).

Status of Critical Habitat in the Northern Oregon Coastal Basins. Critical habitat has been designated for OC coho salmon in streams in the North Coast basins. Many large and small rivers support significant populations of OC coho salmon, including the Nehalem, Nestucca, Siletz, Yaquina, Alsea, Siuslaw, Umpqua, Coos, and Coquille.

The historical disturbance regime in the central Oregon Coast Range was dominated by a mixture of high and low-severity fires, with a natural rotation of approximately 271 years. Old-growth forest coverage in the Oregon Coast Range varied from 25 to 75% during the past 3000 years, with a mean of 47%, and never fell below 5% (Wimberly *et al.* 2000). Currently the Coast Range has approximately 5% old-growth, almost all of it on Federal lands. The dominant disturbance now is timber harvesting on a cycle of 30 to 100 years, with fires suppressed.

In 2005, the State of Oregon assessed habitat conditions in the range of OC coho (ODFW 2005). Oregon's assessment mapped how streams with high intrinsic potential (HIP) for coho salmon rearing are distributed by land ownership categories. Agricultural lands and private industrial forests have by far the highest percentage of land ownership in high IP areas and along all OC coho salmon stream miles. Federal lands have only about 20% of coho stream miles and 10% of HIP stream reaches. Because of this distribution, activities in lowland agricultural areas are particularly important to the conservation of OC coho salmon.

The OC coho salmon assessment concluded that, at the scale of the entire domain, pools are generally abundant although slow-water and off-channel habitat (which are important refugia for coho during high winter flows) are limited in the majority of streams when compared to

reference streams in minimally-disturbed areas. Degraded water quality is also a limitng factor in this area. Amounts of large wood in streams are low in all four ODFW monitoring areas and land-use types relative to reference conditions. Amounts of fine sediment are high in three of the four monitoring areas, and were comparable to reference conditions only on public lands. Approximately 62 to 91% of tidal wetland acres (depending on estimation procedures) have been lost for functionally and potentially independent populations of coho.

As part of the OC coho salmon assessment, the Oregon Department of Environmental Quality (ODEQ) analyzed the status and trends of water quality in the range of OC coho salmon using the Oregon water quality index, which is based on a combination of temperature, dissolved oxygen, biological oxygen demand, pH, total solids, nitrogen, total phosphates, and bacteria. Using the index at the species scale, 42% of monitored sites had excellent to good water quality, and 29% show poor to very poor water quality. Within the four monitoring areas, the North Coast had the best overall conditions (6 sites in excellent or good condition out of 9 sites), and the Mid-South Coast had the poorest conditions (no excellent condition sites, and only 2 out of 8 sites in good condition). For the 10-year period monitored between 1992 and 2002, no sites showed a declining trend in water quality. The area with the most improving trends was the North Coast, where 66% of the sites (6 out of 9) had a significant improvement in index scores. The Umpqua River basin, with one out of 9 sites (11%) showing an improving trend, had the lowest number of improving sites.

Status of Critical Habitat in Puget Sound. Critical habitat has been designated in Puget Sound for PS Chinook salmon. Major tributary river basins in the Puget Sound basin include the Nooksack, Samish, Skagit, Sauk, Stillaguamish, Snohomish, Lake Washington, Cedar River, Sammamish River, Green River, Duwamish River, Soos Creek, Puyallup River, White River, Carbon River, Nisqually River, Deschutes, Skokomish, Duckabush, Dosewalips, Big Quilcene, Elwha, and Dungeness Rivers.

Salmon life history stages that require properly functioning freshwater habitat components have been affected by natural and man-made influences. In the steep mountainous and foothill areas of the Puget Sound basin, relatively unconsolidated glacial deposits and heavy rainfall make this region vulnerable to landslides (WDNR 1993, WDNR 1997a, WDNR 1997b). Lands prone to shallow rapid landslides are often managed for timber, because they are unsuited to most other uses. Landslides can occur naturally, but inappropriate land use practices greatly accelerate their frequency.

Fine sediment enters the channel from unpaved roads. Unpaved roads are widespread on forestlands, and to a lesser extent, in rural residential areas and recreational forestlands. Forestlands throughout the Puget Sound basin have extensive networks of unpaved roads.

Historic or old growth timber harvest removed most of the riparian trees from the stream channels. 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, invasive canary grass and blackberries, and provide substantially reduced shade and LWD recruitment.

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 results in 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).

Loss of riparian habitat, elevated water temperatures, elevated levels of nutrients, increased nitrogen and phosphorus, and higher levels of turbidity, presumably from urban and highway runoff, wastewater treatment, failing septic systems, and agriculture or livestock impacts, have been documented in many Puget Sound tributaries.

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.

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS Chinook salmon populations in a number of river systems. The construction and operation of dams have blocked access to spawning and rearing habitat (*e.g.*, Elwha River dams block anadromous fish access to 70 miles of potential 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. These actions tend to promote downstream channel incision and simplification, limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often change flow rates, stranding and killing fish, and reducing aquatic invertebrate (food source) productivity (Hunter 1992).

If migrating fish are diverted into unscreened or inadequately screened water conveyances or turbines, unnecessary mortality results. Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in many Puget Sound tributary basins.

The nearshore marine habitat has been extensively altered and armored by industry activities and intensive residential development near the mouths of many of Puget Sound's tributaries. A railroad runs along large portions of the eastern shoreline of Puget Sound, eliminating natural cover along the shore and natural recruitment of beach sand.

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. 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 2003a and 2003a).

In summary, critical habitat throughout the Puget Sound basin has been degraded by numerous management activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of LWD, intense urbanization, agriculture, alteration of floodplain and stream morphology (*i.e.*, channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, timber harvest, and mining. Changes in habitat quantity, availability, and diversity, and flow, temperature, sediment load and channel instability are common limiting factors in areas of critical habitat.

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). An environmental baseline that does not meet the biological requirements of a listed species may increase the likelihood that adverse effects of the proposed action will result in jeopardy to a listed species or in destruction or adverse modification of a designated critical habitat.

The NMFS describes the environmental baseline in terms of the habitat features and processes necessary to support all life stages of each listed species within the action area. Each listed species considered in this Opinion resides in or migrates through the action area. Thus, for this action area, the biological requirements for salmon and steelhead are the habitat characteristics that support successful completion of spawning, rearing, freshwater migration, and transition to saltwater.

The biological requirements of salmon and steelhead vary depending on the life history stage and the natural range of variation present within aquatic systems (Groot and Margolis 1991, NRC 1996, Spence *et al*. 1996). During spawning migrations, adult salmon and steelhead require clean water with cool temperatures and access to thermal refugia, dissolved oxygen near 100% 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, oxygen concentrations), substrate stability during high flows, and, for most species, water temperatures of 13°C 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 impede movements of adult or juvenile fish.

Salmon and steelhead also require properly functioning estuary habitat. Estuaries represent one of three major stages in the life cycles of salmon and steelhead. In the ocean, juveniles grow to adults as they forage in food-rich environments. The estuary is where juveniles and adults undergo vast physiological changes needed to transition to and from saltwater. In addition, a properly functioning estuary provides high quality growth conditions for growth and refugia from predators.

The condition of aquatic habitats on Federal lands and adjacent lands where Wyden Amendment projects may occur (collectively referred to as Federal land hereafter) varies from excellent in wilderness, roadless, and undeveloped areas to poor in areas heavily impacted by development and natural resources extraction (FEMAT 1993, McIntosh *et al*. 1994, Wissmar *et al.* 1994, Lee *et al.* 1997). The Action Agencies' proposed restoration actions that are the subject of this programmatic Opinion would typically be carried out in areas degraded by one or more human activity or natural events.

West of the Cascade Mountains in Oregon and Washington, stream habitats and riparian areas have been degraded by road construction, timber harvest, splash damming, urbanization, agricultural activities, mining, flood control, filling of estuaries, and construction of dams (Sedell *et al.* 1991; FEMAT 1993; NMFS 1996). Road construction has increased the drainage network of watersheds, created fish passage barriers at road-stream crossings, and increased delivery of fine sediments. Timber harvest has removed shade-providing trees, decreased recruitment of large woody debris, and increased delivery of fine sediments to streams. Splash damming to move logs severely degraded steam channels by removing habitat elements such as boulders and large woody debris and increasing stream width-to-depth ratios. Mining of gravel and precious metals removed natural stream substrates, created tailing piles in riparian areas, and altered stream channels. Flood control projects straightened stream channels. Construction of dams has blocked fish passage, altered natural hydrologic cycles, and interrupted bedload movement.

East of the Cascade Mountains in Oregon and Washington, aquatic habitats on Federal lands have been degraded by road building, timber harvest, splash damming, livestock grazing, water withdrawal, agricultural activities, mining, urbanization, and construction of reservoirs and dams (USDA and USDI 1994b; McIntosh *et al*. 1994; Wissmar *et al.* 1994; Lee *et al*. 1997). As with areas west of the Cascades, road construction has increased the drainage network of watersheds, created fish passage barriers at road-stream crossings, and increased delivery of fine sediments. Timber harvest has removed shade-providing trees, decreased recruitment of large woody debris, and increased delivery of fine sediments to streams. Splash damming severely degraded stream channels by removing habitat elements such as boulders and large woody debris and increasing stream width-to-depth ratios. Unmanaged livestock grazing has led to incised stream channels, removal of riparian vegetation, alterations of riparian vegetation communities, increased stream width-to-depth rations, and trampled streambanks. Water withdrawal reduces base flows in streams in montane environments where natural base flows are already low. Water diversion structures can block fish passage and unscreened diversions can entrain fish into canals where they become trapped and die. Streams have been straightened and diked to accommodate transportation infrastructure. Mining of precious metals has left large mine tailing piles in riparian areas and added fine sediment to streams. In some areas, stream channels have been completely destroyed by dredge mining. Abandoned mines often leach contaminated water into

streams. Construction of dams and reservoirs has blocked fish passage, altered natural hydrologic cycles, and interrupted bedload movement.

Some water diversions on Federal lands pre-date the establishment of National Forests or BLM Districts. In these cases, the Action Agencies do not have discretion over diversion of water from Federal to private lands. Effects of this water diversion include decreased base stream flow, partial or complete blockage of fish passage, and entrainment of fish into canals if the diversion is unscreened.

The condition of critical habitat was summarized in the previous section of this Opinion and the condition of critical habitat PCEs on Federal lands varies from excellent to poor. The condition of critical habitat PCEs in the action areas addressed by this consultation (areas where restoration projects will occur) is generally poor.

Past Federal actions that affect all action areas addressed by this consultation include the adoption of broad-scale land management plans in 1994. For Federal lands in Oregon and Washington, all activities are subject to the provisions of the Northwest Forest Plan (NFP) (USDA and USDI 1994a) or PACFISH (USDA and USDI 1994b). In response to the ESA listing of the northern spotted owl and the declining aquatic habitat condition on Federal lands, the Action Agencies developed these plans, each of which includes an aquatic conservation strategy. The NFP and PACFISH establish measurable goals for aquatic and riparian habitat, standards and guidelines for land management activities that may affect aquatic habitat, and restoration strategies for degraded habitat. Prior to adoption of these plans, the Action Agencies lacked a consistent aquatic conservation strategy and protection of stream and riparian function were not always a priority. Although the Action Agencies have been challenged to fully implement these strategies, the plans themselves represent a major step forward in protection of anadromous fish habitat.

The protections afforded anadromous fish and their habitat by the NFP and PACFISH have resulted in improvements in riparian and stream habitat conditions on Federal lands in Oregon and Washington. Many land management activities, such as riparian timber harvest, road construction, and intensive livestock grazing that degraded habitat in the past are now managed to avoid impacts to listed salmon and steelhead. The establishment of riparian reserves or riparian conservation areas has switched the focus of management in these areas to achievement of riparian management objectives rather than extractive resource management. The Action Agencies have implemented a restoration program that is focused on aquatic habitat limiting factors and restoring ecosystem function.

The environmental baseline also includes the anticipated impacts of all Federal projects in the action area that have already undergone formal consultation. From 1997 to 2006, NMFS conducted 113 formal consultations with the Forest Service in Oregon, and 24 formal consultations with the Forest Service in Washington. In Oregon, 86 formal consultations were conducted with the BLM while no formal consultations occurred with the BLM in Washington. None of these consultations reached a jeopardy or adverse modification of critical habitat conclusion.

Of the consultations completed with the Forest Service in Oregon, 19 were restoration projects, 55 were natural resources management projects (*i.e.,* timber harvest, grazing, road maintenance, mining, special use permit, herbicide application *etc.*), and 39 were projects that involved both restoration actions and natural resource management. In Washington, consultations completed with the Forest Service include 4 restoration projects, 15 natural resource management projects, and 5 projects that involved both restoration actions and natural resource management. For the BLM in Oregon, 3 consultations were conducted on restoration projects, 70 on natural resource management projects, and 13 on projects that involved both restoration actions and natural resource management. It is very likely that the action areas for some of these consultations will overlap with action areas for restoration projects covered under this programmatic consultation. Impacts to the environmental baseline from these previous projects vary from short-term adverse effects to long-term beneficial effects. A small number of actions addressed by these consultations, such as water diversion in Eastern Washington and precious metals mining in Northeast Oregon result in longer term adverse effects that do not rise to the level of adverse modification of critical habitat or jeopardy.

Under the current environmental baseline, the biological needs of salmon and steelhead are being met on some Federal lands in Oregon and Washington and not being met in others. Since a typical action area of a restoration project will be already degraded in one form or another, at least some biological requirements of salmon and steelhead are like to be unmet. The purpose of the actions proposed in this consultation is to restore these degraded habitat conditions.

Effects of the Action

'Effects of the action' means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). The restoration actions addressed by this programmatic Opinion will all have long-term beneficial effects to salmon, steelhead, and their habitat. These beneficial effects will improve three salmon and steelhead VSP parameters: abundance, productivity, and spatial structure. These improvements will translate into decreased risk of extinction for all of the species addressed by this consultation. Restoration projects carried out in critical habitat will improve the condition of that habitat at the site and watershed scale. In watersheds where multiple restoration projects are carried out, greater improvement of the condition of critical habitat at the watershed scale will be realized.

The actions selected for this programmatic consultation all have predictable effects regardless of where on federal lands in Oregon and Washington they are carried out. Most of the adverse effects from the proposed action are short-term in nature and are caused by construction activities in or adjacent to the stream. NMFS has evaluated these effects in many individual consultations over the past ten years. The knowledge gained from these individual consultations has been applied by NMFS and the Action Agencies to compose the activity design criteria and conservation measures for this consultation. Restoration activities that did not have predictable effects (*i.e.,* channel reconstruction projects) or aspects of included activity categories that introduced uncertainty into our effects analysis (*i.e.,* tidegate replacement) were not included.

Monitoring and reporting will be entered into the Public Consultation Tracking System (PCTS) consultation initiation and reporting system. This internet-based system will allow NMFS to track projects implemented under this consultation and their individual and cumulative effects. Information gathered under this system will be useful in evaluating the success of the program.

The actions will also have some minor, unavoidable, short-term adverse effects such as increased stream turbidity and riparian disturbance. NMFS worked closely with the Action Agencies to incorporate conservation measures into the proposed action to minimize these adverse effects. However, short-term effects are not completely avoidable and some are still reasonably certain to occur. For this reason, the Action Agencies have determined that the proposed activity categories are "likely to adversely affect" listed salmon, steelhead, and their critical habitat.

Most short-term adverse effects of the proposed activity categories result from near- and instream construction. The analysis begins with an evaluation of construction related effects then moves to an activity category specific habitat-based assessment of other, non-construction effects. The analysis continues with an evaluation of how these habitat effects impact individual fish and salmonid population VSP and concludes with an assessment of effects on critical habitat.

Effects of Near and Instream Construction. Many of the activity categories (primarily Group 1 activity types) including, but not limited to, large wood, boulder, and gravel placement, head-cut stabilization, bank restoration, culvert, and bridge projects require the operation of heavy equipment in the riparian areas and active stream channel. Unavoidable short-term adverse effects resulting from these activities include disturbance of riparian vegetation, exposure of bare soil, increased stream turbidity, increased fine sediments in stream substrates, and increased risk of chemical contamination from fuel and lubricants. If work area isolation is required, listed fish will be captured and relocated.

Access to construction sites typically requires removal of riparian vegetation and creation of temporary access paths. Operation of heavy equipment, including excavators, dumps trucks, and bulldozers, in or near streams can compact soil, thus reducing soil permeability and infiltration. Any work that occurs along the streambanks can destroy or damage shade- and cover- providing vegetation and damage the streambank itself. Excavation of streambanks to place large wood or other structures will expose bare soil and release some fine sediment into streams. Release of fine sediments into streams causes elevated turbidity and increased fine sediment in downstream substrates.

The literature reports that suspended sediment and turbidity influences on fish range from beneficial to detrimental. Elevated total suspended solids (TSS) have been reported to enhance cover conditions, reduce piscivorus fish/bird predation rates, and improve survival, but elevated TSS have also been reported to cause physiological stress, reduce growth, and adversely affect survival. Although fish that remain in turbid waters experience a reduction in predation from piscivorus fish and birds (Gregory and Levings 1998), chronic exposure can cause physiological stress responses that can increase maintenance energy and reduce feeding and growth (Redding *et al.* 1987, Lloyd *et al.* 1987, Servizi and Martens 1991). Of key importance in considering the detrimental effects of TSS on fish are the frequency and the duration of the exposure, as well as

the TSS concentration. Juvenile salmonids tend to avoid streams that are chronically turbid, such as glacial streams or those disturbed by human activities, unless the fish traverse these streams along migration routes (Lloyd *et al.* 1987). Construction activities addressed by this consultation are likely to last two weeks at a maximum. During that time, juvenile salmonids may experience decreased feeding, stress, or be unable to use the action area, depending on the severity of the turbidity. Although this represents a significant behavioral change, the temporal and spatial scale of the impact is too small to cause any population level effects.

As suspended fine sediment settles out downstream from the construction areas, minor increases in stream substrate embeddedness occurs. Suttle *et al.* (2004) report that increases in fine sediments in stream substrates can decrease productivity and habitat quality for juvenile salmonids. Waters (1995) describes how elevated fine sediment levels in streams impair physical and biological processes. Significant increases in fine sediment levels reduce interstitial spaces between substrate particles, leads to shifts in invertebrate community structure, fills pools, and can entomb redds. In such cases, eggs are smothered, prey available for rearing juveniles is reduced, and habitat features are lost.

When heavy equipment is operating in the riparian areas or stream, there is always the potential for fuel or other contaminant spills. Operation of bulldozers, excavators, and other equipment requires the use of fuel and lubricants which, if spilled into the channel of a waterbody or into the adjacent riparian zone, can injure or kill aquatic organisms. Petroleum-based contaminants (such as fuel, oil, and some hydraulic fluids) contain polycyclic aromatic hydrocarbons (PAHs), which can be acutely toxic to salmonids at high levels of exposure and can cause acute and chronic sublethal effects on aquatic organisms (Neff 1985).

Direct effects on juvenile salmonids from work area isolation and fish relocation include mechanical injury during capture, holding, or release, and potential horizontal transmission of disease and pathogens and stress-related phenomena. Stress approaching or exceeding the physiological tolerance limits of individual fish can impair reproductive success, growth, resistance to infectious diseases, and survival (Wedemeyer *et al.* 1990). If electrofishing is used to salvage fish, it will particularly increase stress loads. Harmful effects of electrofishing are detailed by Snyder (2003) and include internal and external hemorrhage, fractured spines, and death. Although some listed salmonids will die from electroshocking, fish will only be exposed to the stress caused by work area isolation activities once and the fish relocation is only expected to last a few hours. If construction took place without work area isolation, more fish would be injured or killed.

The Action Agencies propose a suite of conservation measures intended to reduce the short-term effects caused by near and instream construction. Limiting instream construction to low flow periods and using sediment control measures greatly reduce the amount of fine sediment and turbidity created by the restoration actions. Refueling and servicing equipment outside the riparian area reduces the chance of spilling toxic fuels and lubricants. Development and implementation of a pollution and erosion control plan limit any potential adverse effects of a toxic material spill by ensuring that spill response materials are on site during all construction activities. Ensuring that all heavy equipment that will operate instream is cleaned and free of leaks will also reduce the introduction of contaminants into the aquatic environment. The Action

Agencies propose several conservation measures to limit stress and mortality during work area isolation and fish relocation. Limiting the Group 1 activities to in-water work periods will greatly the chance of affecting adult fish, as these periods are designated to avoid times when adult salmonids are present.

Activity Category Specific Effects.

Large Wood, Boulder, and Gravel Placement. Placement of large wood, boulders, and gravel will result in unavoidable short-term construction related effects as described above but will increase stream habitat complexity, increase overhead cover, and help reestablish natural hydraulic processes in streams over time. No matter where these activities occur on Federal lands in Oregon and Washington, we expect an increase in habitat functions, improvements to VSP parameters, and a reduction in the risk of extinction to listed species. Numerous authors have highlighted the importance of large woody debris to lotic ecosystems (Bilby 1984, Keller *et al.* 1985, Spence *et al*. 1996, Lassettre and Harris 2001). Large wood influences channel morphology, traps and retains spawning gravels, and provides food for aquatic invertebrates that in turn provide food for juvenile salmonids. Large wood, boulders, and other structures provide hydraulic complexity and pool habitats that that serve as resting and feeding stations for salmonids as they rear or migrate upstream to spawn (Spence *et al.* 1996).

Land management actions such as logging, road building, stream clearing, and splash damming carried out over the last 150 years have greatly reduced the amount of large woody debris and boulders in streams in Oregon and Washington (Murphy 1995, McIntosh *et al.*1994). The Action Agencies propose this activity category to return these important elements to stream ecosytems. Addition of large wood is a common and effective restoration technique used throughout the Pacific Northwest (Asbridge 2004). Roni and Quinn (2001a) found that large woody debris placement can lead to higher densities of juvenile coho salmon during summer and winter and higher densities of steelhead and cutthroat trout in the winter. These authors also found that addition of large wood to streams with low levels of wood can lead to greater fish growth and less frequent and shorter fish movements (Roni and Quinn 2001b).

As with large wood, addition of boulders and properly designed rock structures can help restore natural stream processes and provide cover for rearing salmonids. Roni *et al.* (2006) found that placement of boulder weirs in highly disturbed streams of Western Oregon led to increased pool area and increased abundance of trout and coho salmon. Addition of gravel in areas where it is lacking, such as below impoundments, will increase spawning substrate available to salmon and steelhead. Although little research has been conducted on the effectiveness of gravel augmentation in improving salmonid spawning, Merz and Chan (2005) found that gravel augmentation can result in increased macroinvertebrate densities and biomass, thus leading to more food for juvenile salmonids.

The proposed design criteria and conservation measures ensure that the Action Agencies will place woody debris and boulders and gravel in a natural manner to avoid unintended negative consequences. This activity category will result in numerous long-term beneficial effects including increased cover and resting areas for rearing and migrating fish and restoration of natural stream processes.

Reconnection of Existing Side Channels and Alcoves. Side channels and alcoves serve as important rearing habitat for juvenile salmonids. Many side channels and alcoves have been blocked from main stream channels for flood control or other land management activities. The Action Agencies propose to remove these blockages and reconnect these areas. Because the creation of new side channels or alcoves can entail a considerable risk of channel collapse, the Action Agencies propose only to cover reconnection of existing side channel and alcove habitat in this consultation.

This activity requires in-water and near-water construction and will have the short-term, construction-related adverse effects described above. However, once completed, reconnection of side channel and alcove habitat increases the available amount of this important habitat type and provides refugia for juvenile fish during high flows. No matter where these activities occur on Federal lands in Oregon and Washington, we expect an increase in habitat functions, improvements to VSP parameters, and a reduction in the risk of extinction to listed species. This is especially important for coho salmon, which require this type of habitat for over-wintering (NRC 1996).

Head-cut Stabilization and Associated Fish Passage. The Action Agencies propose to stabilize active or potential head-cuts with large woody debris, rock, or weirs. This head-cutting primarily takes place in Rosgen (1996) C- and E-type channels in areas east of the Cascade Mountains in Oregon and Washington. In these areas, historic land management such as heavy livestock grazing and road construction has destabilized stream channels and increased the chance of head-cut formation. Stabilization requires instream construction, so short-term construction related adverse effects as described earlier will occur.

The Action Agencies propose aggressive treatments to prevent further incision of stream channels including use of rock and log and rock weirs. Generally, these somewhat unnatural approaches are not favored by restoration planners. However, in the cases of head-cuts and channel incision, it can take so long (decades to centuries) for channels to return to their former elevation afterwards, that more aggressive restoration techniques are sometimes necessary to stop the ongoing damage. The Action Agencies also propose temporary head-cut stabilization, in which case fish passage may be blocked. In these circumstances, the fish passage must be reestablished during the subsequent in-water work period. This may block fish passage for several months, but without this treatment, head-cut formation might also block fish passage.

The beneficial effects of this proposed activity result primarily from the action's prophylactic nature. Left unchecked, head-cuts lead to channel incision, deposition of fine sediments in downstream substrates, and disconnection of a stream from its floodplain. Stabilizing head-cuts will stop the progression of these adverse effects. No matter where these activities occur on Federal lands in Oregon and Washington, we expect an increase in habitat functions, improvements to VSP parameters, and a reduction in the risk of extinction to listed species.

Bank Restoration. The Action Agencies propose to stabilize eroding streambanks using bioengineering methods. This requires instream construction with short-term effects as described above. Heavy equipment might be used in the stream for this activity. 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. However, because of the seasonal restrictions imposed by in-water work windows, these effects will be avoided.

The use of rock groins, weirs, rock toes, and riprap to avoid the potential negative effects of using hard structures to stabilize streambanks has been excluded by the Action Agencies. Long-term beneficial effects of stabilizing eroding streambanks include reductions in fine sediment inputs. Eliminating a sediment source will help to increase the diversity and densities of aquatic macroinvertebrates used as a food source by covered fish species. It will also maintain or increase the amount of interstitial cover available to juveniles and juvenile emergence success. Suffocation of fry and entombment caused by excessive siltation of spawning gravels will also be reduced or eliminated. Light penetration, which, in turn, affects the feeding abilities of covered fish species and juvenile growth rates, will improve.

By limiting bank restoration to bioengineering methods such as placement of large woody debris and riparian plantings, overhead cover for fish will be increased and streambank stability will improve.

Fish Passage Culvert and Bridge Projects. The Action Agencies propose the replacement or removal of fish passage barriers caused by improperly sized or improperly functioning culverts and bridges. This activity requires significant instream construction, isolation of the work area from flowing water, and relocation of fish. The construction-related effects described above will occur at all culvert and bridge project sites. The Action Agencies propose to replace culverts using the stream simulation method, in which natural stream substrates will be placed in the bottom of these structures.

Long-term beneficial effects of culvert and bridge replacement or removal projects include restoration of fish passage and restoration of natural stream channel processes through removal of channel constricting structures. 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.

However, the removal of fish passage barriers could have short-term (typically lasting less than one week, depending on the duration of instream 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. However, because of the seasonal restrictions imposed by in-water work windows, these effects will be avoided.

Fish passage impediments are common throughout Oregon and Washington and restoration planning efforts have highlighted the need to restore fish passage, particularly when the blockage occurs low in a watershed.

Conservation measures and design criteria proposed by the Action Agencies ensure that new culverts and bridges do not constrain stream channel during flows reaching ordinary high water level. Culverts are restricted to a 6% gradient due to the difficulties of maintaining natural stream substrates in culverts placed at high gradients. Baffled and other non-typical culverts requiring special circumstances are not covered by this Opinion. The use of riprap is limited to protection of the outlets and inlets of culverts and for protection of bridge abutments.

Irrigation Screen Installation and Replacement. The Action Agencies propose to install, upgrade, or replace off-channel fish screens on existing water diversion structures and to remove unneeded diversion structures that impound less than 15 acre-feet of water. These activities will require near or instream construction, so related effects as described above will occur. It is important to note that the proposed activity considered in this consultation is limited to the installation or replacement of fish screens. The analysis of effects in Action Agencies' BA and this consultation do not consider the effects of stream flow diminution caused by water withdrawals. Any effect to listed salmon, steelhead, or their habitat caused by lack of stream flow is not covered by this consultation. Installation of screens will occur only on existing diversion, and no additional water withdrawals points will be established. Additionally, no greater rates of water withdrawal will be authorized. This consultation makes no implied or expressed decision on the legality of existing irrigation diversions on Federal lands.

Unscreened or improperly screened irrigation diversion structures can entrain fish into canals where they become trapped and die. If approach velocities are too fast, fish can also be impinged against the screen surface. To avoid any effects from improperly designed screens, all proposed screen installations or replacements will meet NMFS fish passage criteria.[8]

The primary long-term beneficial effect of properly screening diversions is decreased salmonid mortality. Although it is well accepted that screens prevent fish from dying, NMFS cannot predict exactly how many fish would be saved by installing screens on Federal lands in Oregon and Washington. Despite millions of dollars spent on fish screening of water diversions in the Pacific Northwest and California, there have been few quantitative studies conducted on how screening actually affects fish populations (Moyle and Israel 2005). Even though the effects of screening have not been well studied, NMFS recognizes the value of screening and supports the Action Agencies' precautionary approach to screen diversions that may affect listed salmon and steelhead. The removal of unneeded diversion structures improves fish passage and restores natural bedload movement.

In-channel Nutrient Enhancement. Many streams throughout the Pacific Northwest that once had large returns of salmon and steelhead are now lacking the nutrients that decomposing fish carcasses provided. This is especially true for trace marine nutrients (Compton 2006, Murota 2003, Thomas *et al.* 2003). The Action Agencies propose to add salmon carcasses, carcass analogs, or inorganic fertilizers to replace missing nutrients.

[8] Available at: http://www.nwr.noaa.gov/Publications/Guidance-Documents/Passage-Guidance.cfm

The addition of nutrients can increase primary productivity and result in more food for juvenile salmonids (summarized in Reeves *et al.* 1991). 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 conducted in British Columbia have shown that addition of inorganic fertilizers can increase salmonid production in oligotrophic streams (Slaney and Ward 2003, Ward *et al.* 2003, Wilson *et al.* 2003).

Because the effects of these nutrient additions, particularly carcass additions, have not been studied in detail (Compton 2006), the Action Agencies propose numerous conservation measures in conjunction with this activity type. In Oregon, fish carcasses will be certified as disease free by an ODFW fish pathologist and in Washington, placement of carcasses will follow *Washington Department of Fish and Wildlife Habitat Technical Assistance: Nutrient Supplementation* (2004).[9] Following these steps will minimize the chance of introducing disease causing pathogens through carcass supplementation. The Action Agencies will not place carcasses in naturally oligotrophic systems where nutrient levels would be naturally low, and they will not add nutrients to eutrophic systems where nutrient levels are atypically high. Carcass additions will occur during normal spawning periods, so there is a more than negligible chance that some spawning activities could be temporarily interrupted by the addition activities. These interruptions will last for a maximum of a few hours, will only happen once, and are not likely to cause a measurable decrease in spawning success.

Floodplain Overburden Removal. Levees, berms, and dikes are commonly found along mid- to large-sized rivers for flood control or infrastructure protection and can severely disrupt ecosystem function (Gergel *et al.* 2002) and fish community structure (Freyer and Healy 2003). Similarly, mine tailings left by dredging for precious metals can have comparable effects on small streams. Under this activity category, the Action Agencies propose to remove dikes, berms, mine tailings or other floodplain overburden to restore river-floodplain interactions and natural channel-forming processes. This will require near-stream construction, so short-term adverse effects as described previously will occur.

In the long term, removal of floodplain overburden will improve connection between the stream and its floodplain, and allow reestablishment of riparian vegetation. Over time, the removal of overburden will also allow for the restoration of natural channel forming processes. Over the course of many decades, degraded and incised channels will be able to regain meanders, aggrade to the proper elevation, and resume natural formation of habitat features. Ultimately, this will result in more functional fish habitat – streams with overhead cover and undercut banks to provide protection for juvenile fish, low width-to-depth ratios that provide cool and deep refugia for migrating juveniles, and healthy riparian plant communities that provide allocthonous nutrient inputs that drive the food base that juvenile salmonids consume when rearing and migrating to the ocean. More immediate beneficial effects will result from the restoration of "flood pulses" that periodically deliver water, nutrients, and sediment to floodplains.

Reduction of Recreation Impacts. The Action Agencies propose to close or better control recreational activities occurring along streams or within riparian areas. This activity category includes removal of campgrounds, toilets, and trails. It also includes placement of

[9] Available at: http://wdfw.wa.gov/hab/ahg/shrg/index.htm

rocks or other barriers to limit access to streams and gravel surfacing of existing areas prone to erosion. Some construction activities such as removal of campground fill may occur, but construction activities within bankfull stream width will not occur under this category.

Adverse effects of this action include minor riparian disturbance from construction. Long-term beneficial effects result primarily from exclusion of people and vehicles from streams and riparian areas. Reduced streambank damage and reduced chronic disturbance of riparian areas will result from implementation of this activity category. Eliminating gravel-clogging sediment sources (*e.g.*, eroding streambanks) will help to increase the diversity and densities of aquatic macroinvertebrates used as a food source by covered fish species. It will also maintain or increase the amount of interstitial cover available to juveniles and juvenile emergence success. Suffocation of fry and entombment caused by excessive siltation of spawning gravels will also be reduced or eliminated. Light penetration, which, in turn, affects the feeding abilities of covered fish species and juvenile growth rates, will improve. Graveling of areas inside established recreation sites reduces erosion, but also precludes the growth of riparian vegetation in these areas.

Estuary Restoration. The Action Agencies propose to contribute to the restoration of estuary function by removing tide gates, breaching or removing dikes, and removing tiled areas. Over time, the newly-wetted areas will now be open to tidal influence and will be colonized by estuarine plants. Estuaries are key areas for the completion of salmon and steelhead life histories. The transition between fresh and saltwater occurs in estuaries and ocean-type Chinook salmon spend much of their adult life in or near estuary areas (Groot and Margolis 1991). Beneficial effects of estuary restoration include increased vegetative cover for rearing juvenile fish and increased prey.

The types of estuary restoration proposed by the Action Agencies require the operation of heavy equipment. Salmonids that are present in the area during construction may experience increased turbidity, but turbidity is often naturally high in these areas. So, fish behavior will not be significantly altered.

Breaching or removing dikes is proposed by the Action Agencies and is a common practice along the West Coast (Frenkel and Morlan 1991). It is also among the easiest of estuarine restoration methods. Once a dike is breached, allowing tidal exchange, native plants will begin to recolonize. Areas of an estuary that have been filled should readily transform back to a more "natural" state. As with dike breaching, the area should be allowed to recolonize through natural recruitment. This method requires a substantial amount of time to fully develop, but it will have a high rate of success. Maintaining a wetland area through time requires a hydrologic interaction with the landscape (Bedford 1996). Surface elevation controls the hydrology of the site and thus the plant community (Frenkel and Morlan 1991).

Riparian Vegetation Treatment (non-commercial, mechanical). Many riparian areas throughout Oregon and Washington were logged aggressively in the past 100 years. Additionally, fire suppression in dry forests has resulted in unnaturally high tree densities along stream corridors. As a result, many riparian areas are dominated by dense, even-aged stands of small diameter conifers or hardwood species such as alder (*Alnus sp.*). Large-diameter conifers

that provide shade and appropriately-sized large woody debris are typically missing from these areas. The Action Agencies propose to carry out non-commercial thinning, primarily with chainsaws, to restore plant species composition and structure that would occur under natural disturbance regimes. Commercial timber sales, the use of feller-buncher equipment, and road construction are not allowed under this activity category. With the adoption of PACFISH and the NFP, the Action Agencies have discontinued clear cutting in riparian areas. The Action Agencies also report that thinning of older timber plantations in riparian areas has largely been completed in Oregon and Washington.[10] This activity category would be implemented infrequently in most areas, and its most common application would be to reduce small tree density prior to conducting prescribed fire (the effects of prescribed fire in riparian areas are discussed later in this document)

Some studies (Lindh and Muir 2004, Drever 2005) have shown that thinning of conifer or hardwood stands in the Pacific Northwest results in accelerated growth of trees. The Action Agencies propose this activity to accelerate the development of mature stands of large trees along streams to provide large woody debris and wildlife habitat. Short-term adverse effects include minor reductions in stream shade, input of allochthonous materials, and small woody materials. Since the proposed activity does not involve ground-disturbing actions, inputs of fine sediment will not occur.

Riparian and Upland Juniper Treatment (non-commercial). The Action Agencies propose to non-commercially thin western junipers (*Juniperus occidentalis*) to restore montane plant communities to a structure that would occur under natural fire regimes. Of the listed salmon and steelhead addressed by this Opinion, only a portion of the range of MCR steelhead overlaps areas where western junipers represent the dominant plant species. Western junipers have expanded rapidly into neighboring plant communities in the past 130 years primarily due to climatic influences, livestock grazing, and fire suppression (Miller *et al.* 2005). Some authors have concluded that the unnaturally large number of juniper trees currently present in some areas may cause decreased stream flow due to evapotranspiration and increased soil erosion (Miller *et al.* 2005). Other authors (Belsky 1996) conclude that these concerns are only based on anecdotal evidence and observations and potential effects of juniper expansion are generally overstated in their severity. Regardless of one's position on juniper expansion, the restoration of natural plant community structure to riparian areas will be beneficial to stream ecosystems. The goal of this activity is not to favor a particular species or life-history stage, but to provide habitat resembling that in which native species evolved so as to support complete assemblages of these species. For example, the restoration of a natural plant community structure will enhance the production of nutrients and food organisms appropriate for the juvenile life-history stages of native species.

Reductions in stream shade and compaction of soils will result from juniper thinning in riparian areas and associated uplands. Streams where juniper removal would take place are typically small (5 to 15 feet wide), as juniper expansion tends to occur in dry areas. Within the range of MCR steelhead, only streams within the southern portion of the John Day ecological province (Anderson *et al.* 1998) would typically be treated under this activity category. Streams and riparian areas within this arid environment are typically dominated by willow communities,

[10] Telephone conversation on February 14, 2007 with Scott Peets, Forest Service, regarding implementation of this activity category in Oregon and Washington.

willow/herbaceous plant communities, herbaceous meadow plant communities, or sagebrush/herbaceous plant communities (Crowe and Clausnitzer 1997). Reductions in stream shade from juniper removal are likely to be short-lived as the removal of the juniper overstory should increase shrub vigor and stream shade provided by junipers will be replaced by native shrubs. Beneficial effects from juniper treatment to salmonids and their habitat include increased allochthonous inputs from native shrub leaves and potentially, reduced evapotranpiration from junipers.

Riparian Vegetation Treatment (controlled burning). The Action Agencies propose to reduce fuel loads in riparian areas by conducting controlled burns. Controlled burning will be planned and implemented to result in low severity burns as defined in the National Fire Plan (2002). An exception is allowed for burns designed to invigorate aspen (*Populus sp.*) and willow (*Salix sp.*) stands. In these cases, a burn of moderate intensity as defined in the National Fire Plan (2002) is allowed. Moderate burns must be confined to the observable historic boundaries of the aspen or willow sites and must not encompass more than 20% of the riparian area being treated.

This activity is likely to cause some short-term adverse effects on salmonids and their habitats. Riparian areas frequently differ from adjacent uplands in vegetative composition and structure, geomorphology, hydrology, microclimate, and fuel characteristics (Dwire and Kauffman 2003). Consequently, riparian areas typically react to wildfire and prescribed fire differently than adjacent uplands. Although fire can have a wide range of effects on aquatic ecosystems ranging from minor to severe (Reiman *et al.* 2003), the Action Agencies carry out prescribed burns in the spring and fall when fuel moisture and relatively humidity are high. Under these conditions, burns in riparian areas tend to occur in a mosaic pattern, leaving considerable unburned area and resulting in low tree mortality. Areas with the highest moisture levels, immediately adjacent to streams, tend to receive the least damage from fire. Effects from low to moderate intensity prescribed fire in riparian areas include minor reductions in stream shade, minor reductions in large woody debris recruitment and inputs of fine sediment and nutrients to streams. In some cases, large woody debris levels will increase due to prescribed fire (Chan 1998).

Although there is considerable research available on the effects of wildfire on streams and riparian areas, there is considerably less information available on the effects of controlled burns. In a recent study conducted in the Sierra Nevada Mountains of California, Bêche *et al.* (2005) concluded that low to moderate intensity prescribed fire that was actively ignited in the riparian area had minimal effects on a small stream and its riparian zone during the first year post-fire. They observed that the prescribed fire was patchy in terms of intensity, consumption, and severity. The fire was most severe in those areas with large accumulations of conifer litter and debris and usually self-extinguished when it came into contact with moist soil and characteristic riparian vegetation. The prescribed fire did result in a tenfold increase in bare ground (pre-fire: $3.5 \pm 8.2\%$, post-fire: $34.2 \pm 21.8\%$) and a significant decrease in understory vegetation, but did not result in a measurable decrease in riparian canopy cover. Mortality of trees in the riparian areas was low (4.4%). Fine sediment in pools did not increase as a result of the fire, but the authors note that relatively little precipitation occurred post-fire. Little to no response was observed in the macroinvertebrate community. In contrast, Chan (1998) observed a reduced diversity of stream macroinvertebrates due to increased fine sediments one year after a

prescribed burn in Sequoia National Park. In an older study conducted in Atlantic coastal pine forest, Richter (1982) concluded that prescribed fire had limited effects on nutrient cycling, soils, and hydrologic systems.

Gresswell (1999) states that even in the event of extensive high severity wildfires, local extirpation of fishes is patchy and recolonization is rapid. He also warns however, that in situations where native populations of fish have declined, effects from severe wildfires can be longer-lasting. In contrast, Rinne (1996) found that a large wildfire and subsequent hydrologic events on the Tonto National Forest in Arizona effectively extirpated three populations of salmonids in headwater streams and drastically reduced macroinvertebrate densities. In this study, severe effects to streams and aquatic communities were not observed immediately after the fire, but rather after subsequent precipitation events washed exposed fine sediments into streams. The wildfire addressed by this study burned in an area with heavy fuel build-up due to years of fire suppression.

Minshall (2003) reviews the responses of stream macroinvertebrates to fire and concludes that changes to stream macroinvertebrate communities are generally associated with more intense burns (crown fires with at least 50% of a stream's catchment involved). This is far above the expected fire severity resulting from implementation of this activity type. Minshall (2003) also concludes that in unfragmented habitats supporting functional ecosystems, recovery from fire appears to be relatively rapid and that fire can contribute to aquatic productivity and biodiversity. He warns that in disturbed or poorly managed watersheds, impacts from fire are expected to be greater and recovery more protracted. Again, with fire severity expected to be low, effects to salmonid forage will be minor and recolonization will restore macroinvertebrate abundance in one to two years.

In the case of this proposed activity, effects from low to moderate intensity prescribed burns will be much less severe than the effects of intense wildfires considered by Gresswell (1999) and observed by Rinne (1996). Although dead salmonids have been discovered after severe wildfires (Minshall and Brock 1991), it is reasonably certain that individual fish behavior will be not be affected directly by the patchy low-intensity fires caused by this proposed activity. Indirect effects such as reduced forage for juvenile salmonids will be minor and last for a maximum of approximately 1 to 2 years after burning. Over time, juvenile salmonids that receive less food have lower body condition and smaller size at smoltification. However, low-intensity fires should not result in effects this severe.

The primary beneficial effect of reducing fuel loads in riparian areas is reduced chance of severe wildfire. The short-term adverse effects caused by this activity category are minor when compared to the potential adverse effects of severe wildfires.

Riparian Area Invasive Plant Treatment. The Action Agencies propose to control non-native plants in riparian areas by mechanical removal and application of chemical herbicides. The following analysis considers the effects of both plant removal methods. Although NMFS recognizes the need to control non-native plants and restore native plant communities to riparian areas, the use of chemical herbicides close to streams exposes aquatic vegetation, aquatic invertebrates, and salmonids to toxic chemicals. The Action Agencies have proposed

conservation measures to ensure that these chemicals remain out of the water whenever possible. The following section details the thorough analysis conducted to determine what effects invasive plant treatment will have on listed salmon, steelhead, and their habitat.

Disturbance

Manual and herbicide treatment activities occurring within occupied stream channels are likely to disturb juvenile and adult listed fish, and disturb redds. This disturbance is caused by the physical presence of people traveling through streams to complete either manual or chemical treatments. These effects will cause some juveniles and adults to seek alternative habitat, which is likely to contain suboptimal cover and juvenile forage. Fish that seek suboptimal forage and cover will have increased behavioral stress (avoidance, displacement), and sub-lethal responses (increased respiration, reduced feeding success, reduced growth rates). Instream treatment activities are likely to cause some physical injury or death to eggs present in redds or to juvenile fish that do not leave the activity area.

Sediment and Turbidity

Hand pulling or site preparation (for replanting) that is extensive, intensive, and immediately adjacent to a stream course may cause instream fine sediment delivery, resulting in localized sediment deposition or stream turbidity increases. Hand pulling can only occur in areas with limited invasive vegetation as areas of large infestations are typically addressed by techniques not covered by this consultation.

Hand pulling of emergent vegetation is likely to result in localized turbidity increases and mobilization of fine sediments. The degree of effect will be in proportion to the extent of the infestation treated, type of substrate in which the plants are rooted, rooting depth, and whether a hand tool is required for pulling (weed wrench, shovel, *etc.*). Treatment of knotweed and other streamside invasive species with herbicides (by stem injection or spot spray) is likely to result in significant short-term increases in localized fine sediment deposition or turbidity only when treatment of locally extensive streamside monocultures occurs. Localized turbidity increases are likely to cause some juveniles and adults to seek alternative habitat, which is likely to contain suboptimal cover and juvenile forage. Fish that seek suboptimal forage and cover will have increased behavioral stress (avoidance, displacement), and sub-lethal responses (increased respiration, reduced feeding success, reduced growth rates). Other effects of increased turbidity were discussed as a general matter at the beginning of this analysis and are relevant here as well.

Other manual, mechanical, solarization, and herbicide (cut-stump, and wicking and wiping) treatment methods are unlikely to cause fine sediment or turbidity increases. Seed clipping, stabbing, girdling, and cutting typically do not involve ground disturbance or result in bare ground. Solarization may result in bare ground, but is typically small-scale, treating less than 0.1 acre at a time at individual sites. Finally, biological controls typically work slowly over a period of years, and only on target species, and are thus unlikely to lead to bare ground and surface erosion that would increase fine sediment delivery.

Water Temperature

Most mechanical and herbicidal treatments of invasive plant species in riparian areas are not likely to decrease shading of streams. However, in some situations decreased shading is likely to

result, increasing the amount of incident solar radiation reaching the stream and resulting in increased water temperatures. 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 warm-water fish species can increase, potentially extirpating salmon populations through competitive pressure (Reeves *et al.* 1987).

Shade loss that significantly affects water temperature is likely to be rare, occurring primarily from treating streamside knotweed and blackberry monocultures, and possibly from cutting streamside woody species (tree of heaven, scotch broom, *etc.*). The loss of shade would persist until native vegetation reaches and surpasses the height of the invasive plants that were removed. Shade recovery may take one to several years, depending on the success of invasive plant treatment, stream size and location, topography, growing conditions for the replacement plants, and the density and height of the invasive plants when treated.

<u>Chemical Contamination/Nutrients</u>
Three herbicide exposure scenarios were identified that have the potential to adversely affect listed fish:

- Runoff from riparian application
- Runoff from treated ditches and dry intermittent streams
- Application within perennial streams

Each exposure scenario was analyzed to determine the level of acute exposure risk. The risk of chronic exposure from the seven herbicides included in the activity description was analyzed for the USFS Region 6 invasive plant program biological assessment (2005), and that analysis is incorporated by reference and summarized below. The USFS chronic exposure analysis was appropriately edited for this project and saved in the project file.

The chronic effects analysis concluded that an insufficient amount of the proposed herbicides would be applied in the 10 acre/small stream scenario to result in exposure of fish and aquatic invertebrates to chronic effects threshold concentrations for the standard durations (90 days for fish, 21 days for aquatic invertebrates). The analysis also concluded that chronic effects to algae (21 days) from herbicides other than sulfometuron are not possible in this activity description, and that chronic effects to algae from sulfometuron are unlikely. Chronic effects to aquatic macrophytes (21 days) from clopyralid, glyphosate, and sethoxydim were determined not to be possible, not likely to occur for imazapyr, metsulfuron, and sulfometuron, and likely to occur for

chlorsulfuron under some conditions. The chronic exposure analysis determined that adverse effects to aquatic macrophytes are likely for chlorsulfuron when 10 or more streamside acres are treated at application rates greater than about 0.08 pounds a.i.[11]/acre (0.056 pounds a.i./acre is the typical rate, and 0.25 pounds a.i./acre is the maximum rate).

Table 10 (and Table 5) displays the project application buffers and techniques proposed to reduce herbicide exposure. Design criteria include both equipment restrictions and application buffers. Equipment restrictions and application buffers reduce exposure from leaching by reducing herbicide/soil contact in areas nearest to stream channels.

Table 10. Summary of application buffers and techniques to reduce water quality effects.

Herbicide	Perennial/flowing channels		Dry intermittent and ephemeral channels, and ditches	
	Spot spray	Hand/select	Spot spray	Hand/select
Chlorsulfuron	50 feet from bankfull	bankfull	bankfull	allowed through channel/ditch
Clopyralid	15 feet from bankfull	bankfull	bankfull	allowed through channel/ditch
Glyphosate (aquatic)	[1]edge of water, and emergent	edge of water	allowed through channel/ditch	allowed through channel/ditch
Imazapyr	bankfull	bankfull	allowed through channel/ditch	allowed through channel/ditch
Imazapyr (aquatic)	edge of water	edge of water	allowed through channel/ditch	allowed through channel/ditch
Metsulfuron methyl	bankfull	bankfull	allowed through channel/ditch	allowed through channel/ditch
Sethoxydim	15 feet from bankfull	bankfull	bankfull	allowed through channel/ditch
Sulfometuron methyl	bankfull	bankfull	allowed through channel/ditch	allowed through channel/ditch

[1] Hand/select treatment and spot spray of knotweed emergent from streams or ponds with aquatic glyphosate allowed, including stem injection. See design criteria for details.

The risk of adverse effects to listed salmonids and their habitat was evaluated in terms of hazard quotient (HQ) values. Hazard quotients are calculated by dividing the expected environmental concentration by the effects threshold concentration. Given that there are HQ values >1, then adverse effects are likely to occur. Hazard quotient values were calculated for fish, aquatic invertebrates, algae, and aquatic macrophytes.

Adverse effect threshold values for each species group were defined as either 1/20th of the LC_{50} value for listed salmonids, 1/10th of the LC_{50} value for non-listed aquatic species, or the lowest "no observable effect concentration," whichever was lower, found in available literature.

Runoff from Riparian Application

This section addresses exposure risk from herbicide application in riparian areas of both small streams and the margins of larger streams. The analysis is based on the small stream scenario

[11] a.i. = active ingredient

used in the risk assessments performed by Syracuse Environmental Research Associates (SERA) for the USFS,[12] and provides a high risk exposure scenario. The exposure scenario is for a 10-acre herbicide application adjacent to a small stream (base flow of 1.8 cfs) and effects generated by this application are typically greater than the effects resulting from application addressed by this consultation.

Since several relevant parameters of the margins of larger streams are analogous to the small stream scenario modeled, the small stream analysis results are extended to stream margin habitat. Stream margins often provide shallow, low flow habitat, have a slow mixing rate with mainstem waters, and may also be the site at which subsurface runoff is introduced.

Early stage juvenile salmonids, particularly recently emerged fry, often utilize low flow areas along stream margins (Groot and Margolis 1991, Johnson *et al.* 1992, Quinn 2005). As juveniles grow, they migrate away from margins, occupying habitats of progressively higher velocity (Lister and Genoe 1970, Everest and Chapman 1972). Weber and Fausch (2004) found that wild Chinook salmon reared near the river margin until reaching about 60 mm in length. Stream margins are utilized by salmonids for nocturnal resting (Roussel and Bardonnet 1999, Polacek and James 2003), summer and winter thermal refuge, predator avoidance (Roussel and Bardonnet 1999), and flow refuge (Roussel and Bardonnet 1999).

Exposure resulting from riparian applications occurs when rainfall mobilizes herbicides and associated compounds by dissolution and percolation through soils or into surface runoff, and ultimately into stream channels. Soil erosion can also deliver herbicides from riparian applications.

Table 11 summarizes the results of the small stream exposure analysis (Appendix 1, small stream analysis spreadsheet). Water contamination rate (WCR) values used in this analysis are the modeled values reported in the SERA risk assessments. The small stream exposure analysis used WCR values for annual rainfall rates of 15, 50, and 150 inches per year, typical and maximum herbicide application rates, and effects threshold concentrations to calculate HQ values.

The WCR values for annual rainfall rates of 15, 50, and 150 inches were selected to represent climates in eastern Oregon and Washington, the western cascades and western Oregon and Washington valleys, and coastal mountain ranges, respectively. The lowest and highest peak WCR values predicted (by soil type) for each rainfall level, and typical and maximum herbicide application rates, were used to calculate the likely range of HQ values. Modeled peak WCR values increased with higher application and rainfall rates. The primary influence of soil type was lower peak WCR values in loam, largely due to slower leaching.

[12] Syracuse Environmental Research Associates risk assessments are available at: http://www.fs.fed.us/foresthealth/pesticide/risk.shtml

Table 11. Summary of hazard quotient (HQ) values exceeding 1 for small streams.

Species Group	Annual Rainfall (inches)	Chlorsulfuron	Clopyralid	Glyphosate	Imazapyr	Metsulfuron	Sethoxydim	Sulfometuron
Fish	15	---	---	---	---	---	---	---
	50	---	---	---	---	---	A[1]	---
	150	---	---	B[2]	---	---	D[4]	---
Aquatic Invertebrates	15	---	---	---	---	---	---	---
	50	---	---	---	---	---	---	---
	150	---	---	---	---	---	---	---
Algae	15	---	---	---	---	---	---	---
	50	A	---	---	---	---	---	---
	150	C[3]	---	B	A	---	---	---
Aquatic Macrophytes	15	C	---	---	---	---	---	---
	50	D	---	---	---	A	---	---
	150	D	---	---	A	A	---	A

[1]A = HQ >1 at high water contamination rate (WCR) at maximum application rate only
[2]B = HQ >1 at high and low WCR at maximum application rate
[3]C = HQ >1 at high WCR at typical and maximum application rates
[4]D = HQ >1 at high and low WCR at typical and maximum application rates

The letter codes in Table 11 identify HQ exceedences (HQ values > 1), and represent increasing exposure risk for a given species group, with HQ exceedence of "A" the lowest level of exposure risk and "D" the highest. At exposure risk "A", HQ values exceed 1 (the adverse effects threshold) only at the maximum herbicide application rate on the soil type with the highest herbicide yield. At exposure risk "B", HQ values exceed 1 on all soil types at the maximum application rate. At exposure risk "C", HQ values exceed 1 on the soil type with the highest herbicide yield at both the typical and maximum herbicide application rates. At exposure risk "D", the HQ values exceed 1 on all soil types at both the typical and maximum application rates.

The HQ exceedences and their implications for effects to listed salmonids are discussed below by herbicide. The effects conclusions stated for each herbicide are based on the assumption that application occurs over a 10-acre plot adjacent to stream channels containing listed salmonids and/or their habitat.

Chlorsulfuron.

As displayed in Table 11, no chlorsulfuron HQ exceedences occurred for fish or aquatic invertebrates. HQ exceedences did occur for algae at rainfall rates of 50 and 150 inches per year and for aquatic macrophytes at rainfall rates of 15, 50, and 150 inches per year.

The HQ values predicted for algae at 50 inches per year (from Appendix 1) ranged from 0.002 to 2.8, and the HQ exceedence occurred at the maximum application rate on clay soils. The HQ values predicted for algae at 150 inches per year ranged from 0.02 – 5.0, and HQ exceedences occurred at both the typical (HQ of 1.1) and maximum (HQ of 5.0) application rates on clay soils. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall regimes of 50 to 150 inches per year, is likely adversely affect algal production when occurring on soils with poor infiltration.

The HQ values predicted for aquatic macrophytes at 15 inches per year ranged from 0 to 64, and HQ exceedences occurred at both the typical and maximum application rates on clay soils. The HQ values for aquatic macrophytes at 50 inches per year ranged from 0.5 to 585, and ranged from 4.8 to 1,064 at 150 inches per year. The HQ exceedences at 50 and 150 inches per year occurred at both typical and maximum application rates, with lower HQ values occurring on loam soils, and the highest values on clay soils. Given the wide range of HQ values observed among soil types at a given rainfall rate, soil type is clearly a major driver of exposure risk for chlorsulfuron, with low permeability soils markedly increasing exposure levels. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall regimes of 15 to 150 inches per year, is likely to adversely affect aquatic macrophytes. Application on soils with low infiltration rates will have a substantially higher risk of resulting in adverse effects.

Clopyralid.

Application of clopyralid under the modeled scenario did not result in any HQ exceedences for any of the species groups. Clopyralid applications are not likely to adversely affect listed salmonids or their habitat because HQ values are less than 1.

Glyphosate.

Glyphosate HQ exceedences occurred for fish and algae at a rainfall rate of 150 inches per year, and no HQ exceedences occurred for aquatic invertebrates or aquatic macrophytes. The HQ exceedences occurred at the maximum application rates only. The HQ values for fish at 150 inches per year ranged from 1.5 to 3.6, and occurred within a narrow range on all soil types. The HQ values for algae at 150 inches per year ranged from 0.8 to 2.0 in sand. Application of glyphosate adjacent to stream channels at application rates approaching the maximum, in rainfall regimes approaching 150 inches per year, on all soil types is likely to adversely affect listed salmonids. When glyphosate is applied adjacent to stream channels at rates approaching the maximum on sandy soils, in rainfall regimes approaching 150 inches per year, adverse effects to algal production will occur.

Imazapyr.

No HQ exceedences occurred for imazapyr for fish or aquatic invertebrates. HQ exceedences occurred for algae and aquatic macrophytes at a rainfall rate of 150 inches per year.

The HQ values for algae at 150 inches per year ranged from 0 to 1.3. The HQ exceedence at 150 inches per year occurred only at the maximum application rate on clay soils. The HQ values for aquatic macrophytes at 150 inches per year ranged from 0 to 2.0. The HQ exceedence at 150 inches per year occurred only at the maximum application rate on clay soils. Given the range of HQ values observed for imazapyr at a rainfall rate of 150 inches per year, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. Application of imazapyr adjacent to stream channels at application rates approaching the maximum on soils with low permeability, in rainfall regimes approaching 150 inches per year, is likely to adversely affect algal production and aquatic macrophytes.

Algae and macrophytes provide food for aquatic macroinvertebrates, particularly those in the scraper feeding guild (Williams and Feltmate 1992). These macroinvertebrates in turn provide

food for rearing juvenile salmonids. Consequently, adverse effects on algae and aquatic macrophyte production may cause a reduction in availability of forage for juvenile salmonids. Over time, juvenile salmonids that receive less food have lower body condition and smaller size at smoltification. However, the small amount of imazapyr expected to reach the water should not result in effects this severe.

Metsulfuron.

No HQ exceedences occurred for metsulfuron for fish, aquatic invertebrates, or algae. The HQ exceedences for aquatic macrophytes occurred at the maximum application rate on clay soils at rainfall rates of 50 and 150 inches per year. The HQ values ranged from 0.009 to 1.0 at 50 inches, and from 0.02 to 1.9 at 150 inches per year.

Given the range of HQ values observed for metsulfuron at each rainfall level, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. In areas with rainfall rates between 50 and 150 inches per year, application of metsulfuron adjacent to stream channels on soils with low permeability at application rates approaching the maximum is likely to adversely affect aquatic macrophytes. A slight decrease in forage availability for juvenile salmonids will result from adverse effects to aquatic macrophytes.

Sethoxydim.

No HQ exceedences occurred for sethoxydim for aquatic invertebrates, algae, or aquatic macrophytes. The HQ exceedences for fish occurred at rainfall rates of 50 and 150 inches per year, and ranged from 0.3 to 1.0, and from 1.1 to 3.0, respectively. The HQ exceedence at 50 inches per year occurred only at the maximum application rate on loam soils. The HQ exceedences at 150 inches per year occurred at the typical application rate on sand, and at the maximum application rate on loam soil.

The HQ values for sethoxydim were calculated using the toxicity data for the Poast formulation, and incorporates the toxicity of naphtha solvent. The toxicity of sethoxydim alone for fish and aquatic invertebrates is much less than that of the formulated product (about 30 times less toxic for invertebrates, and about 100 times less toxic for fish). Since the naphtha solvent tends to volatilize or adsorb to sediments, using Poast formulation data to predict indirect aquatic effects from runoff leaching is likely to overestimate adverse effects (Durkin 2001). Project design criteria sharply reduce the risk of naptha solvent presence in percolation runoff reaching streams. When design criteria to reduce naptha solvent exposure are employed, application of sethoxydim adjacent to stream channels will not affect listed salmonids or their habitat.

Sulfometuron.

No HQ exceedences occurred for sulfometuron for fish, aquatic invertebrates, or algae. The HQ exceedence for aquatic macrophytes occurred at a rainfall rate of 150 inches per year on clay soils, and HQ values ranged from 0.007 to 3.8.

Considering the range of HQ values observed for sulfometuron at each rainfall level, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. In areas with a rainfall rate approaching 150 inches per year, application of metsulfuron adjacent to stream channels on soils with low permeability at

application rates approaching the maximum is likely to adversely affect aquatic macrophytes. A slight decrease in forage availability for juvenile salmonids will result from adverse effects to aquatic macrophytes.

Runoff from Treated Ditches and Dry Intermittent Streams.
Herbicides applied within ditches and intermittent stream channels are delivered primarily by leaching, dissolving directly into ditch or stream channel flow, and erosion. The contribution from erosion is likely to vary considerably among sites.

Hand/select application of all seven herbicides included in the activity description is allowed within ditches and dry intermittent channels, as is spot spray of glyphosate, imazapyr, metsulfuron, and sulfometuron. Spot spray of chlorsulfuron, clopyralid, and sethoxydim are allowed up to the bankfull level.

The primary determinants of exposure risk from ditch/intermittent channel treatments are herbicide properties, application rate, extent of application, application timing, precipitation amount and timing, and proximity to habitat for listed salmonids. The activity description allows all seven herbicides to be applied up to the maximum rate on the label applicable for treatment within ditches and intermittent channels.

Monitoring of storm runoff has documented that the highest concentrations of pollutants occur during the first storm following treatment (Caltrans 2005, USGS 2001). More specifically, the highest pollutant concentrations generally occur during the early part of storm runoff, relative to concentrations later in the runoff event (Caltrans 2005). The discharge of ditch/intermittent channel runoff in the early stages of the storm hydrograph is generally low, but is exposed to the greatest amount of pollutants available for dissolution. The ratio of low discharge to highest amount of available pollutant results in early runoff solute concentrations that are high relative to those occurring later in the runoff event. Runoff later in the hydrograph occurs at a higher discharge, and dissolved pollutant concentrations are lower, even though mass movement of pollutants can be greater. Therefore, exposure of listed salmonids and their critical habitat elements to the highest concentrations of herbicides resulting from application to ditches and intermittent channels is likely to occur early in storm runoff. The most significant exposure locations are at or near confluences with perennial streams.

In contrast to the well established understanding of the "first flush" effect on pollutant concentrations, little monitoring data is available regarding specific concentrations of herbicides likely to occur in runoff from treated ditches. The USGS (2001) monitoring report cited above provides data for concentrations of sulfometuron and glyphosate in runoff from treated roadside plots into ditches in western Oregon. Sulfometuron was applied at a rate of 0.23 pounds/acre, and resulted in runoff concentrations of 0.119 to 0.253 mg/l (corresponding to about 3 to 7% of amount applied) from simulated rainfall 24 hours following application. Glyphosate was applied at a rate of about 2 pounds/acre, and resulted in runoff concentrations of 0.323 – 0.736 mg/l (corresponding to about 1 to 2% of amount applied) from simulated rainfall 24 hours following application. The samples were collected in the initial 15 liters of runoff from simulated rainfall at a rate of 0.3 inches per hour, and lasting 0.5 to 1.4 hours. Given this sampling scenario, these concentrations are the best estimates available for what would occur in 24-hour, post-application

runoff from ditch/intermittent stream applications from "first flush" events for these herbicides (per amount applied, per unit area).

The runoff concentrations likely for the herbicides in the activity description for which runoff data is not available (clopyralid, imazapyr, metsulfuron, chlorsulfuron, and sethoxydim) can be estimated from the USGS (2001) data. Ramwell *et al.* (2002) and Huang *et al*. (2004) found that herbicides with high solubility and low K_{oc} produced the highest peak concentrations and highest total yield of herbicides in roadside runoff. Krutz *et al.* (2005) stated that herbicide concentrations observed at vegetative filter strip outflows correlate positively with increasing solubility. If solubility and K_{oc} values are reasonable predictors of herbicide yield in ditch runoff, with high solubility and low K_{oc} increasing runoff risk, then it is reasonable to assume that herbicides with solubility values greater than, and K_{oc} values less than or equal to, sulfometuron are likely to be present in runoff at concentrations at least equal to that for sulfometuron. The shortest soil half-life of any of the herbicides is 5 days for sethoxydim, and the others are considerably longer, so it is reasonable to ignore half-life for estimating 24-hour post-application runoff concentrations.

Table 12 summarizes herbicide soil mobility factors (solubility, and K_{oc} ratios) and application rates for the seven herbicides in the activity description. The five herbicides in the activity description for which ditch runoff data is not available (chlorsulfuron, clopyralid, imazapyr, metsulfuron, and sethoxydim) all have K_{oc} values similar to or less than sulfometuron, and much higher solubility. Sulfometuron solubility is low (70 mg/l) relative to the other five herbicides, but a substantial portion of the amount applied appears in the initial runoff. Due to the relatively low application rate of 0.23 pounds/acre, the initial runoff only needs to reach 0.6% saturation to remove 10% of sulfometuron applied. Under circumstances where the ratio of water volume to a low-solubility organic chemical is very large, dissolution is seldom limited by solubility (Lyman 1995). Thus, at low herbicide application rates, solubility of the seven herbicides in the activity description is likely to be less important than K_{oc} as a predictor of runoff risk. It is therefore reasonable to assume that the runoff efficiency of those five herbicides will occur at a rate at least equal to that of sulfometuron following a rainstorm occurring 24 hours post-application. This assumption is consistent with groundwater movement ratings from Vogue *et al.* (1994). In addition, foliar wash-off fractions of these five herbicides were also higher than for sulfometuron (Knisel 2000), indicating that an amount greater than or equal to sulfometuron will be available for dissolution.

Table 12. Summary of herbicide soil mobility factors and application rates.

Herbicide	Solubility[1,2] (mg/l)	K_{oc}[2]	Maximum Application Rate (lbs/acre)[3]
Clopyralid	300,000	6	0.5
Imazapyr	500,000	100	1.5
Metsulfuron	9,500	35	0.15
Chlorsulfuron	7,000	40	0.25
Sethoxydim	4,390	100	0.45
Sulfometuron	70	78	0.38
Glyphosate	900,000	24,000	8

[1] Solubility values are for salts, if salts are typically the ingredient in commercial formulations
[2] From Vogue *et al*. (1994), located at http://npic.orst.edu/ppdmove.htm
[3] From product labels

The average sulfometuron 24-hour post-application concentration reported by USGS (2001) was used to extrapolate likely concentrations of the five herbicides for which comparable monitoring data was unavailable, predict exposure risk to listed salmonids and their habitat, and calculate HQ values. The equation for extrapolation of the USGS (2001) sulfometuron data to chlorsulfuron, clopyralid, imazapyr, metsulfuron, and sethoxydim was derived by treating application rate as the independent variable (x), runoff concentration as the dependent variable (y), and solving for the slope of the line intersecting y = 0, x = 0 (no herbicide was considered to be in runoff if none was applied). The average sulfometuron runoff concentration of the 24-hour simulated rainfall plots was 0.2 mg/l, and the application rate was 0.23 lbs/acre. The resulting estimate of runoff concentration is in mg/l. Thus, where m = slope and b = y intercept:

y = mx + b
y = (runoff concentration/application rate) * x + 0
y = (0.2 mg/l)/0.23 lbs/acre) * x + 0
mg/l in runoff = 0.87 mg/l per lb/acre * application rate in lbs/acre

The results of the extrapolation and resulting HQ values are summarized in Table 13. Runoff rates in Table 13 for sulfometuron and glyphosate are those published in USGS (2001).

The HQ values presented in Table 13 are based on the assumption of application to several hundred feet of ditch/intermittent channel adjacent to a perennial stream with occupied or critical habitat present. Herbicide treatments approaching the maximum rates for ditch/channel lengths greater than a few hundred feet are likely to occur within the project area. However, due to the generally patchy distribution of invasive plant infestations in ditches and intermittent channels, and use of conservative herbicide application methods, treatment of such large, contiguous areas near the maximum application rate is expected to be rare. Treatments of ditch/channel lengths greater than a few hundred feet at the typical rate are likely to be infrequent. Therefore, the estimated herbicide runoff concentrations and consequent HQ values displayed in Table 13 are likely to occur on a rare (for maximum HQ values) to infrequent (for typical HQ values) basis within the project area.

Based on the analysis results presented in Table 13, the summary of the likely adverse effects to listed salmonids and their habitat from 24-hour post-application storm at ditch/intermittent channel confluences with perennial streams is:

- Glyphosate will cause sublethal effects to listed salmonids, generally reducing their fitness and cause adverse effects to their habitat by reducing algae production.

- Sethoxydim will cause sublethal effects to listed salmonids, generally reducing their fitness and adverse effects by reducing production of aquatic invertebrates, algae, and aquatic macrophytes.

- Chlorsulfuron, imazapyr, metsulfuron, and sulfometuron are likely to cause adverse effects to salmonids habitat by reducing production of algae and aquatic macrophytes.

Actual exposure concentrations and durations at or near confluences with perennial streams will depend on a variety of factors, including the extent of the herbicide application within the ditch/intermittent stream, application rate, extent of riparian applications, and rainfall timing, intensity, and amount.

Riparian applications adjacent to ditch/intermittent stream channels may contribute additional herbicide, exacerbating exposures at confluences with perennial streams. However, due to a greater transport lag time through soils, peak herbicide exposures from riparian applications delivered via ditches and intermittent streams are likely to arrive at perennial stream confluences at a later time than the "first flush" peak. This would extend exposure time, but, based on the data used to compile Table 2A (see Appendix1), would be unlikely to increase peak exposure level.

The projected runoff concentrations and HQ values displayed in Table 13 should be interpreted with an understanding of the precision and accuracy of the USGS (2001) data upon which they are based. Although the USGS (2001) results were based on relatively ambitious quality assurance, "it is important to recognize that all of the data presented are semiquantitative in nature and that interpretations should take this into account. These data can be relied on only for order-of-magnitude representations of concentrations, and possibly for trends." Thus, the runoff concentrations and HQ values in Table 13 should be considered as estimates that may vary by an order of magnitude lower or higher. However, the runoff concentrations projected in Table 13 for clopyralid are reasonably consistent (within an order of magnitude) with roadside ditch runoff data for clopyralid reported by Huang *et al.* (2004), and collected under similar conditions.

Table 13. Projected runoff concentrations at typical and maximum application rates, and resulting HQ values

Herbicide	Typical Application Rate (pounds/acre)	Expected Typ. Runoff Concentration (mg/l)	Maximum Application Rate (pounds/acre)	Expected Max. Runoff Concentration (mg/l)	Species Group	Effects Threshold Concentration (mg/l)	Typ Application Rate HQ values	Max Application Rate HQ values
Chlorsulfuron	0.056	0.05	0.25	0.22	Fish	2	0.02	0.11
					Aq. Invertebrates	10	0.005	0.02
					Algae	0.01	5	22
					Aq. Macrophytes	0.000047	1,036	4,625
Clopyralid	0.35	0.30	0.5	0.43	Fish	5	0.06	0.1
					Aq. Invertebrates	21	0.01	0.02
					Algae	0.69	0.4	0.6
					Aq. Macrophytes	0.69	0.4	0.6
Glyphosate	2	0.48	8	1.92	Fish	0.5	1.0	3.8
					Aq. Invertebrates	78	0.006	0.025
					Algae	0.89	0.5	2.2
					Aq. Macrophytes	3	0.2	0.6
Imazapyr	0.45	0.39	1.5	1.30	Fish	5	0.1	0.3
					Aq. Invertebrates	100	0.004	0.01
					Algae	0.02	20	65
					Aq. Macrophytes	0.013	30	100
Metsulfuron	0.03	0.03	0.15	0.13	Fish	4.50	0.01	0.03
					Aq. Invertebrates	17.00	0.002	0.01
					Algae	0.01	2.6	13
					Aq. Macrophytes	0.00016	163	815
Sethoxydim	0.3	0.26	0.45	0.39	Fish	0.06	4	7
					Aq. Invertebrates	0.26	1.0	1.5
					Algae	0.25	1.0	1.6
					Aq. Macrophytes	0.25	1.0	1.6
Sulfometuron	0.03	0.03	0.38	0.33	Fish	4.5	0.006	0.1
					Aq. Invertebrates	6.1	0.004	0.05
					Algae	0.0025	10	132
					Aq. Macrophytes	0.00021	124	1,573

Application within Perennial Streams

Both glyphosate and imazapyr can be applied between the bankfull level and water's edge of perennial streams, and glyphosate can be applied to emergent knotweed plants. Exposure from application within stream channels can occur from overspray, foliar rinse by rainfall, erosion, leaching, and site inundation. Juvenile and fry life stages are likely to be at the highest risk of exposure, and the highest risk sites for exposure are stream margins and areas immediately surrounding treated emergent plants.

Exposure of juveniles in stream margins can result from overspray, upstream storms resulting in inundation of treatment sites, rainfall at the treatment sites delivering herbicide to stream margins via percolation or surface runoff, or a combination of these factors.

Juveniles utilizing stream margin habitat are likely to be present in the low flow refuge near the water's edge as the stream level rises. As inundation of recently treated areas occurs, glyphosate overspray or wash-off present on the substrate surrounding treated plants, or on the treated plants, may enter solution.

Adverse effects to algae and aquatic macrophytes are not analyzed for stream margin exposures resulting from application to dry portions of perennial channels, since any storm-driven adverse effects are assumed to be less than what will have already occurred during treatment of the area.

Glyphosate

Table 14 displays the potential peak exposure levels likely to occur in stream margins for three application rates if the available glyphosate applied per unit area to dry portions of perennial channels is dissolved into 4 inches or 12 inches of water. The amount of glyphosate available for dissolution (62.5% of the amount applied) is based on assumptions of a foliar wash-off fraction of 0.5 (Durkin 2003), and a 25% overspray rate. Table 14 displays potential peak exposure rates and HQ values resulting from three application rates to dry portions of perennial channels at two stream margin depths.

Table 14. Peak glyphosate concentrations in stream margins from in-channel applications.

Application Rate (pounds/acre)	Depth (inches)	[1, 2] Glyphosate Concentration (mg/l)	Hazard Quotient for Salmonids	Percent of Maximum Application Rate
0.5	4	0.35	0.7	6.25
2	4	1.4	2.8	25
8	4	5.5	11	100
0.5	12	0.11	0.2	6.25
2	12	0.45	0.9	25
8	12	1.8	3.6	100

[1] Assumes 25% overspray to substrate and foliar wash-off fraction of 0.5, resulting in about 62.5% of applied glyphosate reaching water.
[2] Assumes no leaching contamination from application occurring above bankfull level.

Numerous factors influence the actual concentration in stream margins near an application site. These are application rate, rainfall proximity and intensity, time since application, soil permeability, and water turbulence and flow rate. Concurrent applications to adjacent riparian

areas (above bankfull) are likely to result in additional exposure. Glyphosate is strongly sorbed by most soils (Yu and Zhou 2005), so exposure levels of glyphosate are likely to be attenuated when channel surface substrate contains a substantial soil component. For treatment of emergent plants, the amount of overspray or injection leakage, and water depth and flow are primary determinants of concentration. Interpolation of data in Table 14 demonstrates that HQ values for salmonids greater than one can result from application to dry portions of perennial channels at a rate of only about 9.5% of the maximum permitted by the label.

Label instructions for the Aquamaster aquatic glyphosate formulation recommend to "always use the higher rate of this product per acre within the recommended range when weed growth is heavy or dense or weeds are growing in an undisturbed (noncultivated) area." For dense infestations, the product label allows an application rate up to 8 pounds/acre. Therefore, it is assumed that application at or near the label maximum is likely to be necessary in some situations for invasive plant control on gravel bars and other instream sites.

Exposure of listed fish from treatment of emergent knotweed with glyphosate is likely to occur via three pathways: overspray, foliar wash-off, and leakage from stem injections. Since delivery via each pathways is driven by different factors (overspray, rainfall, and plant death and breakage), exposure from the three pathways is very unlikely to overlap in time.

Assuming the same overspray rate used for stream margin exposure calculations, 25%, maximum glyphosate concentrations from overspray only at 4-inch water depth would range from 0.14 mg/l at an application rate of 0.5 lbs/acre to 2.2 mg/l at a rate of 8 pounds/acre. The corresponding range of salmonid HQ values is 0.28 to 4.4. For the same application rate values, the maximum exposure concentrations in 12-inch water depth would range from 0.05 to 0.74 mg/l, with salmonid HQ values ranging from 0.1 to 1.5.

For glyphosate, maximum exposure (via rain wash-off from treatment of emergent knotweed, assuming a foliar wash-off fraction of 0.5 and application rates ranging from 0.5 to 8 pounds/acre) maximum exposure concentrations from foliar wash-off only range from 0.21 – 3.3 mg/l at 4 inch depth, with salmonid HQ values ranging from 0.42 – 6.6. For the same application range, maximum exposure concentrations at 12-inch depth range from 0.07 to 1.1 mg/l, with salmonid HQ values ranging from 0.14 to 2.2.

Exposure concentrations resulting from breakage of knotweed stems injected with glyphosate is difficult to predict, due to high uncertainty regarding the amount and rate of glyphosate release. Only a few milliliters of glyphosate are injected per stem, and, assuming that breakage release would likely occur infrequently and from only one stem at a time, instream concentrations exceeding the salmonid effects threshold (0.5 mg/l) are likely to occur only. Adverse effects to aquatic invertebrates, algae, or aquatic macrophytes are not likely to occur.

Imazapyr

Analysis was conducted for imazapyr exposure in stream margins from application to dry portions of perennial channels analogous to that displayed in above in Table 15 for glyphosate. The stream margin exposure analysis for imazapyr was based on assumptions of a foliar wash-

off fraction of 0.9 (Durkin and Follansbee 2004), and a 25% overspray rate. No HQ values exceeded 1 for salmonids or aquatic invertebrates.

Table 15. Peak imazapyr concentrations in stream margins from in-channel applications.

Application Rate (pounds/acre)	Depth (inches)	[1, 2] Imazapyr Concentration (mg/l)	Hazard Quotient for Salmonids	Percent of Maximum Application Rate
0.45	4	0.45	0.09	30
1.5	4	1.53	0.3	100
0.45	12	0.15	0.03	30
1.5	12	0.51	0.1	100

[1] Assumes 25% overspray to substrate and foliar wash-off fraction of 0.9, resulting in about 92.5% of applied imazapyr reaching water.
[2] Assumes no leaching contamination from application occurring above bankfull level.

Herbicide Application Summary

Significant adverse effects to listed fish, and to the algal and aquatic macrophytes habitat elements, are likely to occur. The magnitude and frequency of adverse effects to listed fish and critical habitat are likely to be low. The magnitude and frequency of adverse effects to aquatic macrophytes will be higher for some herbicides (primarily chlorsulfuron, metsulfuron, and sulfometuron) as a result of treating ditches.

Adverse effects to listed fish are likely to result from glyphosate application in all three treatment categories (riparian, ditch/dry intermittent streams, and perennial streams). Significant adverse effects such as increased respiration, reduced feeding success, and subtle behavioral changes that can increase predation risk to listed fish from short-term exposures to low (*i.e*. single digit) HQ exceedences are reasonably likely to occur. When treatments occur that utilize two or more herbicides in close proximity, exposures to mixtures may follow.

Exposures to expected maximum concentrations of the other herbicides in the activity description are not likely to result in adverse effects to listed fish. However, simultaneous exposure to other herbicides may increase the level of adverse effects from glyphosate exposure. Additional adverse effects are most likely to manifest as an additive, and not synergistic, response in fish. Dose addition is considered most appropriate for mixtures with components that affect the same endpoint by the same mode of action, and are believed to behave similarly with respect to uptake, metabolism, distribution, and elimination (Choudhury *et al*., 2000). The precise toxic mechanism(s) in fish are not clearly documented for the seven herbicides contained in the activity description, but effects to the kidney and liver are typical endpoints in terrestrial wildlife. In addition, the proposed herbicides have bioconcentration factors that fall within a range that does not indicate bioconcentration risk (all bioconcentration factors less than 32), are relatively soluble, and their chemical structure indicates that they are likely to behave similarly in salmonids.[13] It is further described in Choudhury *et al*., (2000) that the assumption of similar uptake, metabolism, distribution, and elimination is adequately met in fish for dose-addition analysis at low concentrations. Assuming that sethoxydim HQ values are an overestimation due

[13] Syracuse Environmental Research Associates risk assessments are available at: http://www.fs.fed.us/foresthealth/pesticide/risk.shtml

to volatilization of the naphtha solvent (the primary toxic ingredient of the formulated product), the cumulative HQ values for the seven herbicides under realistic co-exposure scenarios are not likely to exceed that for glyphosate alone for instream application exposure in stream margins.

Significant adverse effects to aquatic invertebrates are not likely to occur from herbicide exposure under any of the treatment categories.

Table 16. Herbicides in treatment categories likely to adversely affect species groups.

	Treatment Categories		
Species Group	**Riparian Areas (above bankfull)**	**Ditches and Intermittent Channels**	**Perennial Channel Instream (dry areas and emergent knotweed)**
Fish	glyphosate	glyphosate	Glyphosate
Aquatic Invertebrates	---	---	---
Algae	chlorsulfuron, glyphosate, imazapyr	chlorsulfuron, glyphosate, imazapyr, metsulfuron, sethoxydim, sulfometuron	---
Aquatic Macrophytes	chlorsulfuron, imazapyr, metsulfuron, sulfometuron	chlorsulfuron, imazapyr, metsulfuron, sethoxydim, sulfometuron	---

Adverse effects to algae and aquatic macrophytes are likely to result from herbicide application in riparian and ditch/intermittent channel applications, but not always from the same herbicides. Adverse effects to algae and aquatic macrophytes that translate to significant indirect adverse effects (via alteration in food supply, cover, *etc.*) to listed fish may not result from brief exposures to herbicide concentrations causing lower (single digit) HQ exceedences. The highest risk to aquatic macrophytes is from intensive application to ditches with chlorsulfuron, metsulfuron, and sulfometuron, where the aquatic macrophytes HQ values for ditch effluent at stream channel confluences can potentially reach several hundred to several thousand, and are likely to translate to significant indirect adverse effects to listed fish. Due to roads acting as seed dispersion corridors, heavy invasive plant infestation of natural intermittent channels is less likely to occur relative to ditches, and thus intensive herbicide application within intermittent channels is also less likely to occur.

The chronic exposure analysis determined that adverse effects to aquatic macrophytes are likely for chlorsulfuron when 10 or more streamside acres are treated at application rates greater than about 0.08 pounds a.i./acre (0.056 pounds a.i./acre is the typical rate, and 0.25 pounds a.i./acre is the maximum rate).

Since the herbicides included in the activity description target four different plant metabolic pathways, additive and synergistic effects to aquatic macrophytes may occur when co-exposure to multiple herbicides results from treatments utilizing two or more herbicides in close proximity.

Riparian Exclusion Fencing (with water gaps and stream crossings). The Action Agencies propose to construct fences to exclude livestock and humans from streams and riparian areas. Fenced enclosures may contain water gaps and crossing sites.

Fencing sensitive riparian areas is a very effective way of protecting riparian resources, fish habitat and fish populations. Platts (1991b) found that in 20 of 21 studies identified, stream and riparian habitats were degraded by livestock grazing, and habitats improved when grazing was prohibited in the riparian zone. Storch (1979) reported that in Oregon, in a reach of Camp Creek passing through grazed areas, game fish (trout) made up 77% of the population in a fenced exclosure, but only 24% of the population outside the exclosure. Line *et al.* (2000) found that excluding livestock through fencing and planting trees in the excluded area significantly reduced nutrient inputs to streams.

Although the net benefits of fencing streams to exclude livestock or humans are clear, some minor adverse effects can occur at watering or crossing sites. Concentration of livestock or human traffic at these areas can result in streambank damage and add fine sediment to stream substrates. Redds created by salmon or steelhead could be trampled if they are located in crossings. The Action Agencies propose several conservation measures to reduce the potential for these types of adverse effects from occurring. Crossings will be located in areas where streambanks are naturally low, crossing widths are limited to 20 feet, and areas of sensitive soils and vegetation will be avoided. Although these measures will reduce the potential for adverse effects, some minor streambank damage is likely to occur in these small areas and a redd could occasionally be trampled.

Riparian Vegetation Planting. The Action Agencies propose to plant riparian vegetation that would naturally occur in the treatment area. This may occur as a stand alone action, or as an action to stabilize areas disturbed by other activities covered by this Opinion. Many authors have discussed the importance of riparian vegetation to stream ecosystems (Murphy and Meehan 1991; Swanston 1991, Hicks *et al.* 1991, Spence *et al.* 1996). Streambanks covered with well-rooted woody vegetation have an average critical sheer stress three times that of streambanks weakly vegetated or covered with grass (Millar and Quick 1998). This is one of the most important actions that can be taken to restore natural processes to stream ecosystems.

Planting in riparian areas may result in very minor fine sediment delivery to streams. It could also temporarily flush fish from hiding cover but it is not expected to result in significant behavior modification of listed salmon and steelhead. In the long term, planting of riparian vegetation will increase shade, hiding cover, woody debris, and streambank stability. This will improve the survival of yearling and other juvenile salmonids by providing appropriate substrate for fry and an increase in cover from predators and high flows. Beneficial effects to fish also include enhanced fitness through improved conditions for forage species and improved reproductive success for adult salmonids as a result of increased deep water cover and holding areas. As plantings mature, width-to-depth ratios of disturbed channels and fine sediment delivery will decrease.

Road Activities. The Action Agencies propose to obliterate unneeded roads and storm-proof roads that will be left open. Over the past century, roads have been constructed throughout

Federal lands in Oregon and Washington to access timber and to mine, facilitate fire suppression, and access recreation areas. The effects of road building and maintenance on fish habitat and watershed function are summarized in Furniss *et al.* (1991). Roads and associated ditch systems increase watershed drainage networks, intercept overland flow, and shift timing of peak flows. Improperly constructed road-stream crossings, particularly culverts, can impede fish passage. During precipitation events, fine sediments can be washed from the road surface into streams. This is especially true for poorly maintained roads. Roads constructed in close proximity to streams constrain the stream channel and eliminate the stream's access to its floodplain. The Action Agencies propose to obliterate unneeded roads or roads that cause adverse impacts to streams or watershed function. In the case of road closures, the Action Agencies will only close roads if the rest of the proposed project substantially addresses restoration of hydrologic function. A minor beneficial effects resulting from road closure is reduced fine sediment inputs at road-stream crossings due to reduced traffic.

Road obliterations near streams will have short-term, construction-related effects as described earlier in this section. In the long term, the proposed road activities will decrease watershed drainage networks, eliminate stream-road crossings, and reduce areas of soil compactions. These beneficial impacts to the landscape will reduce scour-related mortality (and increase survival) of eggs and alevins, reduce involuntary downstream movement of juveniles during freshets, increase substrate interstitial spaces used for refuge by fry, restore the timing of discharge-related life cycle cues (*e.g.*, migrations), and increase spatial structure. Obliterating roads within a stream's floodplain will decrease channel constriction and allow establishment of riparian functions.

Removal of Legacy Structures. During the 1980s and early 1990s, many habitat-forming structures such as log weirs, boulder weirs, and gabions were placed in streams to create pool habitat. Many of these structures were placed perpendicular to stream flow or placed in a manner that interfered with natural stream function. The Action Agencies propose to remove these structures to restore natural stream function. This activity type requires instream construction causing the short-term effects described earlier. Long-term beneficial effects of removing these structures include decreased streambank erosion, decreased stream width-to-depth ratios, and restoration of natural stream processes. Decreasing erosion will increase the survival of eggs and alevins and reduce interference with feeding, behavioral avoidance and the breakdown of social organization. Decreasing the stream width-to-depth rations will increase adult holding areas and improve rearing sites for yearling and older juveniles.

Fisheries, Hydrology, Geomorphology, Wildlife, Botany, and Cultural Surveys in Support of Aquatic Restoration. The Action Agencies often conducted habitat or fish surveys as part of a restoration project. For instance, presence/absence fish surveys are often carried out prior to construction activities to determine if fish relocation will be necessary. Engineering surveys are almost always necessary for culvert replacements and other construction activities. When these surveys are carried out within or in close proximity to streams, harassment of listed salmon and steelhead can occur. In some instances, fish are flushed from hiding cover and can become more susceptible to predation. The disturbance typically lasts a few hours and will not have population level effects. No measurable habitat effects are expected from this proposed

activity category. This activity category does not cover research activities requiring an ESA section 10(a)(1)(A) permit.

Effects on Listed Species

The restoration actions addressed by this programmatic Opinion will all have long-term beneficial effects on three salmon and steelhead VSP parameters – abundance, productivity, and spatial structure. As these improvements are realized, the extinction risk for salmonids addressed by this Opinion will decrease. The proposed restoration activities will not have observable short-term effects on population genetic diversity. Much less is known about the biology of southern green sturgeon than is known about salmon and steelhead. However, because the distribution of southern green sturgeon in the action areas is limited to estuaries, and the deep, low elevation, riverine mainstem of coastal rivers, very few southern green sturgeon are likely to occur in close proximity to any of the projects. Due to the large volume of water and amount of physical habitat available in these areas, the adverse effects of the proposed actions (*i.e.,* turbidity, increased contaminants) on green sturgeon will be insignificant

Projects designed to improve habitat complexity will result in increases in population productivity and abundance. The Action Agencies propose restoration activities to directly add habitat elements and also propose actions that protect stream function and allow habitat elements to form naturally. Addition of habitat features such as large wood and boulders increases hiding cover, aids in the formation of pools, and helps to trap and retain spawning substrates. Vegetation planted in riparian areas often develops into over-hanging structure. Fencing stream reaches prevents streambank damage and allows undercut banks to develop. Overhead cover is important for rearing, migrating, and spawning salmonids (Bjornn and Reiser 1991). Fish that have cover available are less susceptible to predators and disturbance. Similarly, pools provide resting habitat and deep water areas where fish can escape avian predators. Pools also provide important over-wintering habitat and may be the only ice-free areas in high elevation stream. Increased retention of appropriately sized spawning gravel will increase the total amount of spawning habitat available to adult salmonids. Pools, large wood, and boulders also provide eddies and areas of slower water velocity. Juvenile salmonids use these areas as feeding stations because they have lower water velocities but are still close to swifter velocity waters that carry drifting food items such as aquatic insects. Fish can remain in the slower current areas to save energy and then dart out into faster areas to capture food items. The improvements to physical stream habitat resulting from the restoration actions will increase survival of all salmonid life stages. Over time, the increase in survival will translate directly to increases in population abundance and productivity and decreased risk of extinction.

Good water quality is essential to completion of all salmonid life stages (Bjornn and Reiser 1991, Spence *et al.* 1996). Salmon and steelhead require cool, clean, water with ample dissolved oxygen. Throughout Oregon and Washington, water quality is a major limiting factor for salmonids. The Action Agencies propose several restoration actions designed to improve water quality. Planting riparian vegetation and excluding humans and livestock by fencing will speed development of shade-producing vegetation thus reducing stream temperatures. Prescribed burning in riparian areas reduces risk of severe wildfires that would drastically reduce shade levels. Treatment of invasive weeds will allow for recolonization of riparian areas by shade-

providing native plants. Addition of salmon carcasses will add important missing marine nutrients and increase productivity of oligotrophic systems. Salmonids that reside in streams with suitable streams temperatures and low levels of chemical contaminants are less susceptible to disease, are more metabolically efficient, and generally have higher survival. Improvements in water quality will lead to greater survival, abundance, and productivity and decreased risk of extinction of salmonids addressed by this consultation.

The Action Agencies propose some restoration actions that will reconnect blocked habitat. Reconnection of side channel habitat increases the total amount of habitat available and provides important refuge habitat. The proposed estuary restoration reestablishes tidal influence and opens these important nursery areas to juvenile salmonids. Estuary areas are important transitional areas for all species of salmonids, but they are particularly for ocean-type Chinook salmon, such as SR fall-run Chinook salmon, that spend a great deal of time in estuaries and do not make long ocean migrations (Groot and Margolis 1991). Reconnection of these habitat types at a small scale can improve spatial structure and life history diversity of these species.

Many of the proposed restoration actions are designed to decrease the amount of fine sediment entering streams. Salmonids need stream substrates relatively free of fine sediments to successfully complete spawning and incubation (Bjornn and Reiser 1991, Waters 1995, Spence *et al.* 1996). Juvenile salmonids also benefit greatly from low fine sediment levels in substrates (Suttle *et al*. 2004). Invertebrates that provide prey for rearing salmonids also require stream substrates with low (less than 30%) fine sediment levels (Waters 1995). Stabilizing head-cuts and eroding streambanks decreases inputs of fine sediments. Planting riparian vegetation decreases areas of bare soil and provides a sediment filtering buffer. Obliterating roads in riparian areas will decrease delivery of fine sediment to streams, as roads in close proximity to streams can convey large amounts of fine sediments (Furniss *et al.* 1991). As fine sediment decrease in spawning areas, more substrates become suitable for spawning and egg incubation success rates will increase. Rearing juvenile salmonids will have additional interstitial hiding spaces available and greater amounts of prey. These improvements will result in increased survival, abundance, and productivity and decreased risk of extinction of salmonids addressed by this consultation.

Improvements in population spatial structure will result from projects that improve fish passage and restore access to previously blocked streams. Activity categories that improve fish passage include culvert replacement and removal of unneeded irrigation diversions. Improvements in population productivity and abundance typically follow restoration of fish passage if the habitat made available is in good condition. In the case of emergency head-cut stabilization, fish passage may be blocked for a period of several months. However, if not addressed, head-cut formation might also block fish passage. Fish populations that are well distributed spatially are at a lower risk from stochastic events. In addition to improved spatial structure, the additional available spawning and rearing habitat will result in increased population abundance and productivity.

Most adverse effects resulting from the proposed restoration activities are expected to be minor and of short duration (weeks to two years). Degraded water quality and increased turbidity resulting from instream construction will last a maximum of a few weeks. Riparian disturbance

and disturbed soils resulting from accessing work sites will stabilize and begin to revegetate in one year. These more intense adverse effects are primarily caused by the Group 1 actions. Because the Action Agencies propose to limit the total number of projects occurring in a watershed in any year, the aggregate short-term negative effects of restoration actions will interfere with over-all watershed function.

Adverse effects to listed fish will result from glyphosate applications. Adverse effects such as increased respiration, reduced feeding success, and subtle behavioral changes that can increase predation risk to listed fish will occur. Other effects from herbicide treatments on listed fish are primarily indirect in the form of reduced algae production and reduced invertebrate production. Due to the proposed design criteria and conservation measures for herbicide treatments, the occurrence of these effects will infrequent. No observable effect on population abundance or productivity will occur.

Fish relocation will result in stress and possible mortality for a small number of fish. The stress of relocation will last only a few hours and will only happen once. A small number of other adverse effects resulting from the proposed restoration actions (such as bank trampling at water crossings and preclusion of riparian vegetation at graveled recreation sites) will persist into the future but occur at such a small scale that they will not have any observable effects on population abundance and productivity.

All the populations of salmon and steelhead addressed by this Opinion are at abundance levels far below historic and are listed as threatened or endangered. Only one species, SR sockeye salmon, is currently at critically low levels. In the area covered by this consultation, this species is only found migrating in the mainstem Columbia River where any adverse effects will be minimal. The short-term adverse effects resulting from the proposed restoration actions will not affect enough fish of the other species to have a measurable effect on population productivity and abundance. This is because the populations composing these species are distributed over a large area and any given project is likely to affect only a very small number of individuals. Even in watersheds where a maximum number of higher impact projects (10) are carried out, the total number of individuals affected would still be small compared to overall population abundance. Any reduction in spatial structure of fish populations (fish passage blockage) will last a few hours to a maximum of a few days and in-water work is timed to avoid spawning migration periods. As summarized above, the beneficial effects of the proposed actions such as improved water quality, increased overhead cover, reduced input of fine sediment, and improved fish passage will result in improvements to salmonid population abundance, productivity, and spatial structure.

Effects on Critical Habitat

Effects on critical habitat are a subset of the habitat-based effects described earlier. The critical habitat analysis begins with a summary of the effects of the proposed restoration activity categories on critical habitat PCEs. An evaluation of how changes in PCEs affect conservation value at the watershed scale and then the species-wide scale follows.

Freshwater spawning sites

Water quantity: The proposed activity categories will not reduce water quantity with the exception of construction actions that require work area isolation. In these cases, water quantity in a very small area, typically a maximum of several thousand square feet, may be reduced for a period of hours or days. Projects that are designed to improve stream-floodplain connection such as floodplain overburden removal and reconnection of existing side channels will result in greater storage of water in the floodplain. This will result in small improvements in late season stream flow.

Water quality: Short-term adverse effects to water quality will occur when near or in-water construction occurs. Increased turbidity and increased levels of chemical contaminants resulting from construction will last for a few hours to a maximum of a few weeks. Minor inputs of chemical herbicides as described earlier will degrade water quality for a period of hours to days.

In the long term, the proposed restoration activities are designed to improve water quality. Planting riparian areas creates shade and thus reduces summer stream temperatures. Projects designed to reduce streambank erosion and inputs of fine sediments from unneeded roads will decrease turbidity.

Substrate: Fine sediments mobilized by construction activities will settle out in downstream substrates resulting in a minor increase in substrate embededdness. Prescribed fire will result in some small inputs of fine sediments to streams. Over the long term, many restoration activity categories are designed to reduce inputs of fine sediment. The proposed road activities, reduction of recreation impacts, and streambank restoration will reduce chronic input of fine sediments.

Freshwater rearing sites

Water quantity: Water quantity will be affected as described above.

Floodplain connectivity: No adverse effects to floodplain connectivity will occur, but long-term beneficial effects are expected from several activity categories including floodplain overburden removal, and reconnection of existing side channels and alcoves. These actions will restore interaction betwixt the stream and its floodplain, raising the water table and improving general riparian function.

Water quality: Water quality will be affected as described above.

Forage: Minor reductions in invertebrate forage will occur as a result of increased fine sediment generated by construction activities. This will affect to a few hundred feet below construction sites, and these areas will be recolonized by invertebrates within a few months. Short-term reductions in algae and macroinvertebrates will occur as described in the analysis of herbicide effects. Prescribed burning can result in decreased macroinvertebrate densities and diversity. In the long term, all of the restoration activity categories that improve riparian function reduce inputs of fine sediments, and help to encourage establishment of healthy riparian plant community, will resulting in increased terrestrial and aquatic forage.

Natural cover: Riparian disturbance caused by construction activities may result in some minor reduction of overhead cover at project sites. In the long term, many restoration activity categories such as large wood and boulder placement, riparian fencing, streambank restoration, and riparian planting will improve cover for salmon and steelhead.

Freshwater migration corridors

Free passage: Construction activities may temporarily impede fish passage for a maximum of a few days. Proposed culvert replacement, tide gate removal, and removal of irrigation diversions will all improve fish passage.

Water quantity: Water quantity will be affected as described above.

Water quality: Water quality will be affected as described above.

Natural cover: Natural cover will be affected as described above.

Estuarine areas

Free passage: Construction activities in estuarine areas may temporarily impede fish passage for a maximum of a few days. Removal of tide gates and berms will improve fish passage, allowing access to previously blocked estuary areas.

Water quality: The proposed estuary restoration projects will improve water quality, primarily by reconnecting the estuary to tidal waters.

Water quantity: The proposed estuary restoration actions will not affect water quantity, other than by reestablishing tidal influence.

Salinity: The proposed removal of tidegates and berms will reestablish tidal influence and allow periodic inundations of saltwater. This will restore natural salinity levels to estuary areas.

Natural cover: The restoration of tidal influence and natural plant communities will provide more cover for salmon and steelhead when they are present in estuaries.

Juvenile forage: Juvenile salmon and steelhead feed primarily on small to mid-sized invertebrates while in estuaries (Groot and Margolis 1991). Estuary restoration projects that restore natural vegetation and tidal influence will increase the amount of forage available for juvenile salmonids.

Adult forage: Adult salmon and steelhead feed on small fish and invertebrates in estuary areas (Groot and Margolis 1991). Reestablishment of natural vegetation, tidal influence, and estuary function improves habitat for salmon, steelhead, and their forage species. The proposed estuary restoration will increase the amount of forage available for adult salmon and steelhead.

Effect of the Restoration Actions on the Conservation Value of Critical Habitat at the Watershed and Designation-wide Scales

NMFS used the watershed or subbasin (5th or 4th HUC) to designate critical habitat units. Organizing information at this scale is especially relevant to salmonids, since their innate homing ability allows them to return to the watersheds where they were born. Across Oregon and Washington, there are several hundred watersheds with designated critical habitat for one or more listed salmonids. Most of the watersheds with critical habitat on Federal lands were rated as having high or medium conservation value.[14] Very few watersheds on Federal lands were rated as having low conservation value.

As summarized above, the proposed restoration actions will all have long-term beneficial effects to critical habitat PCEs at the watershed scale. The adverse effects to PCEs are expected to be minor and persist for a short time (typically a few weeks). The Action Agencies proposal to limit the number of Group 1 activities to ten per watershed per year ensures that aggregate adverse effects from restoration projects will not interfere with watersheds processes. In each and every watershed where restoration actions are carried out in, the improvements to the condition of PCEs will improve the ability of these watersheds' habitat to contribute to the conservation of listed salmon and steelhead.

At the species-wide scale, the condition of critical habitat varies greatly from pristine to highly degraded. For many species, such as MCR steelhead and SRB steelhead, much of their critical is found on Federal lands. For other species, much of the remaining functional habitat is on Federal lands. Improvements to watershed condition resulting from the proposed actions will collectively enhance the ability of the listed salmon and steelhead to recover to a point where listing under the ESA is no longer necessary.

Cumulative Effects

'Cumulative effects' are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Cumulative effects that reduce the ability of a listed species to meet its biological requirements may increase the likelihood that the proposed action will result in jeopardy to that listed species or in destruction or adverse modification of a designated critical habitat.

Between 1990 and 2000, the population of Oregon grew from 2,860,400 to 3,431,066, an increase of approximately 20%[15] and the population of Washington grew from 5,021,335 to 5,894,121, an increase of approximately 17%[16]. Both states are projected to grow by 1.4%to 2.0% each year for the next 5 years. Thus, NMFS assumes that future private and state actions will continue within the action areas, increasing as population density rises.

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[14] See CHART report at: http://www.nwr.noaa.gov/Salmon-Habitat/Critical-Habitat/2005-Biological-Teams-Report.cfm

[15] Information available at: http://www.oea.das.state.or.us/DAS/OEA/docs/economic/appendixc.pdf

[16] Information available at: http://www.ofm.wa.gov/pop/stfc/stfc2006/stfc2006.pdf

The most common private activity likely to occur in the action areas addressed by this consultation is unmanaged recreation. Although the Action Agencies manage recreational activities to some degree (*i.e.,* campgrounds, trailheads, OHV trails), a considerable amount of dispersed unmanaged recreation occurs. Expected impacts to salmon and steelhead from this type of recreation include minor increases in turbidity, impacts to water quality, short-term barriers to fish movement, and minor changes to habitat structures. Streambanks, riparian vegetation, and spawning redds can be disturbed wherever human use is concentrated.

Some recreational mining, primarily small-scale suction dredging that is not subject to regulation by the action agencies also occurs on Federal lands. This mining causes increases in turbidity, minor riparian disturbance, and harassment of salmon and steelhead. The intensity of mining is somewhat dependent on the price of precious metals, but occurs at low levels in most areas.

Recreational fishing within the action area is expected to continue to be subject to ODFW and WDFW regulations. The level of take of ESA-listed salmon and steelhead within the action area from angling is unknown, but is expected to remain at current levels.

When considered together, these cumulative effects are likely to have a small negative effect on salmon and steelhead population abundance, productivity, and some short-term negative effects on spatial structure (short-term blockages of fish passage). Similarly, the condition of critical habitat PCEs will be slightly degraded by the cumulative effects.

Conclusion

Southern Green Sturgeon. NMFS concludes that the proposed action is not likely to adversely affect southern green sturgeon. This conclusion is based on the following considerations. Southern green sturgeon occur in the action areas only in estuaries, and the deep, low elevation, riverine mainstem of coastal rivers. NMFS has not completed a detailed viability assessment of southern green sturgeon but has determined that the primary threat facing this species is the reduction in the number and geographic distribution of spawning areas, which do not occur within the action areas of this proposed action. Other identified threats related to the destruction, modification, or curtailment of green sturgeon habitats are also limited to the geographic range of green sturgeon outside the action areas for this proposed action. Fisheries, including trophy poaching, are another significant threat to this species, but will not be affected by the proposed action. The only potential adverse effects of the proposed action on southern green sturgeon is likely to occur as a result of the proposed action is short-term degradation of water quality due to increased turbidity and contaminants due to minor riparian and channel disturbance. Those effects are expected to be insignificant because the intensity will be very low and confined primarily to shallow water habitats not frequented by southern green sturgeon.

Salmonids. After reviewing the status of the ESA-listed salmon and steelhead addressed by this Opinion, the status of their designated critical habitats, the environmental baseline for the action areas, the effects of the proposed actions, and cumulative effects, NMFS concludes that the actions, as proposed, are not likely to jeopardize the continued existence of these species, nor are they likely to destroy or adversely modify their designated critical habitat. These conclusions are based on the following considerations.

The salmon and steelhead species addressed in this Opinion have declined due to numerous factors. The one factor for decline that all these species share is degradation of freshwater and estuarine habitat. Human development of the Pacific Northwest has caused significant negative changes to stream and estuary habitat across the range of ESA-listed salmon and steelhead.

All of the actions addressed by this consultation are intended to improve the condition of, and restore natural processes to, degraded aquatic habitats. Some minor short-term negative effects will occur as a result of implementing these actions. The conservation measures and design criteria proposed by the Action Agencies ensure that these effects remain minor and are scheduled to occur at times that are least sensitive to salmon and steelhead life cycles. Only one species, SR sockeye salmon, covered by this Opinion, is at critically low levels. In Oregon and Washington, SR sockeye are only found migrating through the mainstem Columbia and Snake rivers. None of the proposed activities are likely to affect this species while they are present in these large riverine systems. This because the river corridors are so large and contain such a large volume of water and this species is present at such low numbers that the chance of short-term adverse effects overlapping with the presence of this species is discountable. The other species, although currently well below historic levels, are distributed widely enough and are presently at high enough abundance levels that any short-term adverse effects resulting from restoration actions will not have an observable effect on population abundance or productivity. As summarized in the effects of the action section, the short-term effects will last a maximum of a few weeks and affect only a small percentage of the inviduals comprising any given salmonid population. As a result of the revegetation efforts proposed by the Action Agencies, riparian areas disturbed by the proposed actions will generally recover within in a year.

Long-term, beneficial effects from improving habitat conditions will result in increased population productivity and abundance. These beneficial effects include improved water quality, increased overhead cover, and reduced input of fine sediment. These improvements to habitat quality will increase the chance that affected salmonids will be able to successfully complete all life history stages. Spatial structure of salmon and steelhead populations will improve as a result of the proposed restoration actions; most notably due to improved fish passage. The removal of fish passage barriers, such as undersized culverts, will allow access to blocked habitat. Diversity of salmon and steelhead populations will not change as a result of the proposed actions.

The condition of critical habitat on Federal lands throughout Oregon and Washington varies greatly. Implementation of the proposed actions will cause some minor short-term adverse effects to critical habitat PCEs. These effects will last for a few days to a few months. The long-term beneficial effects of the restorative actions will persist for decades or longer. The conservation value of critical habitat will increase as a result of the actions implemented under this Opinion. The positive habitat effects resulting from the proposed actions include improved water quality, increased overhead cover, and reduced input of fine sediment. These improvements to critical habitat PCEs will increase the chance that affected salmonids will be able to successfully complete all life history stages. The free passage PCE of critical habitat will improve as a result of the proposed action most notably due to improved fish passage. The removal of fish passage barriers such as undersized culverts will allow access to currently blocked habitat. This concludes formal consultation.

Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. The following recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the Action Agencies:

- NMFS, along with co-managers, partner agencies including the FS and BLM, and local groups, is currently developing recovery plans for ESA-listed salmon and steelhead in Oregon and Washington. Some of these plans are currently available in draft or final form at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Index.cfm. NMFS encourages the Action Agencies to consider the recommended actions and prioritization plans found in current draft and forthcoming recovery plans when planning restoration projects on Federal lands.

Please notify NMFS if the Action Agencies carries out this recommendation so that we will be kept informed of actions that minimize or avoid adverse effects and those that benefit listed species or their designated critical habitats.

Reinitiation of Consultation

Reinitiation of formal consultation is required and shall be requested by the Federal agency or by NMFS 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 designated 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 designated critical habitat that was not considered in the biological opinion; or (d) if a new species is listed or critical habitat is designated that may be affected by the identified action (50 CFR 402.16). This programmatic consultation expires on December 31, 2012. New projects should not be implemented under this consultation after that date. To reinitiate consultation, contact the Oregon or Washington State Habitat Office of NMFS and refer to the NMFS Tracking Numbers assigned to this consultation.

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 wounds or kills an individual of a listed species, modifies its habitat in a way that significantly impairs 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.

Amount or Extent of Take

Completion of the proposed restoration activities will take place beside and within streams and estuaries occupied by Lower Columbia River Chinook salmon, Upper Columbia River spring-run Chinook salmon, Puget Sound Chinook salmon, Snake River fall-run Chinook salmon, Snake River spring/summer-run Chinook Salmon, Upper Willamette River Chinook salmon, Columbia River chum salmon, Hood Canal summer-run chum salmon, Snake River sockeye salmon, Southern Oregon/Northern California coho salmon, Oregon Coast coho salmon, Lower Columbia coho salmon, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Columbia River steelhead, Snake River Basin steelhead, Upper Willamette River steelhead and Puget Sound steelhead. Due to the short-term adverse effects of implementing restoration activities, incidental take is reasonably certain to occur. The degraded habitat that will be affected by the proposed restoration actions will typically be of marginal quality and not limited at the site-specific or watershed scale. Incidental take caused by the adverse effects of the proposed actions will include the following:

1. Capture of listed juvenile salmonids during work area isolation, some of which will be injured or killed. NMFS anticipates that each year, up to 33,000 juvenile individuals of the species considered in this consultation are likely to be captured during work areas isolation and up to 1,550 of those individuals will die. To obtain this estimate for the number of fish captured, NMFS considered the maximum number of Group 1 projects that will occur (500) and assumed that at most 60% of these projects will require work area isolation. Not all Group 1 activities (*i.e.,* road decommissioning) will require work area isolation and fish capture and relocation. Discussions with the Action Agencies indicate that a typical fish relocation in the past resulted in the capture of 100 salmonids or less. Using an estimate of 100 salmonids per relocation event and adding an additional 10% to account for situations where more fish might be encountered, a maximum total of 33,000 captured fish was obtained. Because the individual fish that are likely to be captured, injured, or killed by work area isolation are from different species that are similar to each other in appearance and life history, and to unlisted species that occupy the same area, it is not possible to assign this take to individual species. NMFS will, however, allocate this take evenly across recovery domain areas, as it is more practical to predict which fish will be present in these defined areas. In each recovery domain (Puget Sound, Oregon Coast, Lower Columbia/Willamette, and Interior Columbia Basin), up to 10,000 juvenile salmonids may be taken during work area isolations each year. Of the ESA-listed salmonids to be captured and handled in this way, 98% or more are expected to survive with no long-term effects and 1 to 2% are expected to be injured or killed, including delayed mortality because of injury. Nonetheless, the more expansive estimate of 5% lethal take will be used here to allow for variations in experience and work conditions. NMFS does not anticipate that any adult fish will be captured. SR sockeye salmon are only present in the mainstem Snake and Columbia rivers in Oregon and Washington. The proposed actions will not affect members of this species while migrating through these large rivers. No incidental take is anticipated or exempted for this species.

2. Near and instream construction activities required for Group 1 activities will result in an increase in turbidity and pollutants that will cause juvenile fish to move away from the action area. Construction activities will also cause a minor increase in fine sediment levels in downstream substrates, temporarily reducing the value of that habitat for spawning and rearing. Operation of heavy equipment will destroy riparian vegetation and damage streambanks, temporarily reducing cover for juvenile and adult salmonids. Take will occur at the project site and as much as 1,000 feet downstream. Incidental take, other than fish capture, caused by implementing Group 1 activity types cannot be accurately quantified as a number of fish. This is because the future abundance and distribution of listed fish, in relation to the habitat effects of the actions, is indeterminate and so a specific number of individuals taken cannot be predicted. For Group 1 activities, the extent of take is best identified by the extent of the turbidity plume generated by construction activities and the total amount of Group 1 project covered by the Action Agencies. For each Group 1 project, the Action Agencies shall reinitiate consultation at a project scale if the turbidity plume generated by construction activities is visible above background levels 2,500 feet downstream from the project areas. The Action Agencies should reinitiate on the entirety of this consultation if they cover more than the number of Group 1 projects identified in Table 17 in any given year.

3. In some cases, Group 2 activities will cause harm or harassment of listed salmonid juveniles and adults. Take resulting from Group 2 activities will occur primarily as harassment or as harm caused by increased delivery of fine sediments to streams and human activities in or around streams. For instance, surveys carried by the Action Agencies will disturb fish, causing them to leave areas with overhead cover and become more susceptible to predation. Prescribed burning will expose soils in riparian areas, resulting in increased delivery of fine sediments to streams. Unlike take resulting from Group 1 activities, take resulting from Group 2 activities will occur sporadically, over a larger area. The total amount of incidental take resulting from Group 2 activities will be much lower than the amount of take occurring from Group 1 activities. Incidental take, caused by implementing Group 2 activity types cannot be accurately quantified as a number of fish. This is because the future abundance and distribution of listed fish, in relation to the effects of the actions, is indeterminate and so a specific number of individuals taken cannot be predicted. For Group 2 projects, the extent of take is best identified by the total number of stream miles affected and the total number of projects implemented in each recovery domain. The Action Agencies report in the BA that the average length of stream miles affected by their Group 2 restoration projects is 1.2 miles per project. The Action Agencies shall reinitiate consultation on the entirety of this consultation if they cover more Group 2 projects than the number identified in Table 17 or affect more than the identified stream miles in any recovery domain in a given calendar year.

Table 17 summarizes the amount and extent of incidental take identified for this programmatic consultation.

Table 17. Amount or extent of incidental take by recovery domain for restoration actions cover by this programmatic consultation. Consultation must be reinitiated if the amount or extent of take is exceeded for any domain.

Recovery Domain *Species Present*	**Maximum number of fish captured during work area isolation per year**	**Maximum number of Group 1 projects to be implemented in any year**	**Maximum extent of turbidity plume from Group 1 projects in feet**	**Maximum number of Group 2 projects to be implemented in any year**	**Maximum number of stream miles affected by Group 2 projects in any year**
Puget Sound *Puget So. Chinook salmon* *Hood Chan.chum salmon*	6000	75	2500	100	120
Oregon Coast* *SONCC coho salmon* *OC coho salmon*	10000	175	2500	250	300
Lower Columbia/Willamette *LCR. Chinook salmon* *UWR Chinook salmon* *CR chum salmon* *LCR coho salmon* *LCR steelhead* *UWR steelhead*	8000	100	2500	125	150
Interior Columbia Basin* *SR Sp./Su. Chinook salmon* *SR Fall Chinook salmon* *UCR Chinook salmon* *SRB steelhead* *UCR steelhead* *MCR steelhead*	9000	150	2500	175	210

*Additional projects are expected in these areas due to the large amount of Federal lands found throughout the range of species in these recovery domains.

Reasonable and Prudent Measures

Reasonable and prudent measures are nondiscretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o)(2) to apply. The Action Agencies have the continuing duty to regulate the activities covered in this incidental take statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) will lapse if the Action Agencies fail to exercise their discretion to require adherence to terms and conditions of the incidental take statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions.

The NMFS believes that full application of conservation measures included as part of the proposed action, together with use of the reasonable and prudent measures and terms and conditions described below, are necessary and appropriate to minimize the likelihood of incidental take of listed species due to completion of the proposed action.

The Action Agencies shall:

1. Minimize incidental take from the proposed activity categories.

2. Ensure completion of a monitoring and reporting program to confirm that the Terms and Conditions in this Incidental Take Statement are effective in avoiding and minimizing incidental take from permitted activities.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the Action Agencies and their cooperators, if any, must fully comply with conservation measures described as part of the proposed action and the following terms and conditions that implement the reasonable and prudent measures described above. Partial compliance with these terms and conditions may invalidate this take exemption, result in more take than anticipated, and lead NMFS to a different conclusion regarding whether the proposed action will result in jeopardy or the destruction or adverse modification of designated critical habitats.

1. To implement Reasonable and Prudent measure #1, the Action Agencies shall:

    a. Ensure that all proposed conservation measures and design criteria for each activity type are implemented.
    b. Follow the appropriate state (ODFW or WDFW) guidelines for timing of in-water work to minimize effects to listed species. Exceptions to ODFW and WDFW in-water work windows will be requested from NMFS. Work window exceptions can be approved through documented phone conversations, e-mail messages, or written correspondence with the local NMFS branch office.
    c. Ensure the survival of at least 80% of plantings used in revegetation activities for at least 3 years post-planting.

2. To implement Reasonable and Prudent measure #2 (monitoring and reporting), the Action Agencies shall:

    a. Use the NMFS Public Consultation Tracking System- Consultation Initiation and Reporting System (CIRS) (http://www.nmfs.noaa.gov/pcts) when this online system becomes available and Action Agency staff have been trained to use it. Prior to the CIRS becoming available, the Action Agencies shall provide the following information in paper form to the NMFS Oregon State Habitat Office (OSHO) for projects implemented in Oregon, or the Washington State Habitat Office for projects implemented in Washington State.
    b. The following information shall be provided:
        i. A project notification report will be provided at least 30 days prior to implementation of any proposed project. This report should contain the following:
            (1) Location: 6th field HUC, 12 digit code, and name.
            (2) Timing: Anticipated project start and dates.

(3) Activity Type: Identify all proposed activity types that apply.
(4) Project Description: Brief narrative of the project and objectives.
(5) Extent: Number of stream miles to be treated.
(6) Species Affected: Listed fish and or wildlife species, critical habitat, and or EFH affected by the project.

ii. Project Completion Report will be provided within 120 days of project completion. This report should contain the following:
(1) Timing: Actual project start and end dates.
(2) The extent of the turbidity plume generated by any in-water construction activities.
(3) Agency contact information: Agency and project lead name.
(4) Fish Handling: If fish are handled during rescue operations the project biologist will describe removal methods, stream conditions, and the number of fish affected. This report will likely be limited to culvert replacement projects.
(5) Post-project assessment: The results of the Action Agencies' post-project assessment should be report to NMFS.

c. Prior to the launch of the CIRS system, the Action Agencies shall track implementation of this programmatic consultation at a regional level to ensure that the amount and extent of take identified in Table 17 is not exceeded.

NOTICE. If a sick, injured or dead specimen of a threatened or endangered species is found in the project area, the finder must notify NMFS through the contact person identified in the transmittal letter for this Opinion, or through NMFS Office of Law Enforcement at 1-800-853-1964, and follow any instructions. If the proposed action may worsen the fish's condition before NMFS can be contacted, the finder should attempt to move the fish to a suitable location near the capture site while keeping the fish in the water and reducing its stress as much as possible. Do not disturb the fish after it has been moved. If the fish is dead or dies while being captured or moved, report the following information: (1) NMFS consultation number (found on the top left of the transmittal letter for this Opinion), (2) the date, time, and location of discovery, (3) a brief description of circumstances and any information that may be relevant to the cause of death, and (4) photographs of the fish and where it was found. NMFS also suggests that the finder coordinate with local biologists to recover any tags or other relevant research information. If the specimen is not needed by local biologists for tag recovery or by NMFS for analysis, the specimen should be returned to the water in which it was found, or otherwise discarded.

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 1998a), coastal pelagic species (PFMC 1998), and Pacific salmon (PFMC 1999). The proposed action and covered area are detailed above in the Introduction Section of this document. The USDA Forest Service, USDI Bureau of Land Management, and USDI Bureau of Indian Affairs are the action agencies for the proposed Program for Fish Habitat Restoration Activities in Oregon and Washington. The covered area includes habitats designated as EFH for various life-history stages of Pacific salmon, groundfish, and coastal pelagic species (Table 17). 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 States of Oregon and 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 BA and the analysis of effects presented in the Effects of the Action section 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 17 no adverse impacts to EFH or HAPCs of those species are anticipated.

The BA clearly identifies 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 road decommissioning; head-cut stabilization; large wood, boulder, or gravel placement; culvert replacement; and removal of instream legacy structures. NMFS determined that the action will have adverse effects on EFH for Chinook salmon, coho salmon, and pink salmon as follows:

1. Short-term degradation of water quality (turbidity) from road decommissioning; head-cut stabilization, large wood, boulder, or gravel placement, culvert replacement activities, and removal of instream legacy structures.
2. Short-term degradation of water quality (temperature) from reduction in riparian shade during riparian vegetation treatments that open the forest canopy.

3. Short-term reduction in the extent of small woody debris available for recruitment to streams and sediment capture (affecting structural components of instream habitat).
4. Short-term reduction in salmon food sources as a result of herbicide treatments to control invasive plant species.

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 Effects of the Action section of this document.

Essential Fish Habitat Conservation Recommendations

The conservation measures included in the BA 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 Forest Service, BLM, and BIA intend to implement these conservation measures to minimize potential adverse effects to the maximum extent practicable. NMFS recommends that in order track implementation of restoration actions that occur in EFH. The Action Agencies implement the following conservation recommendation:

The Action Agencies should use the NMFS Public Consultation Tracking System- Consultation Initiation and Reporting System (CIRS) (http://www.nmfs.noaa.gov/pcts) when this system becomes available and the Action Agency staff have been trained to use it.

Prior to the CIRS becoming available, the Action Agencies should provide the following information in paper form to the NMFS Oregon State Habitat Office for projects implemented in Oregon, or the Washington State Habitat Office for projects implemented in Washington State.

1. A project notification report will be provided at least 30 days prior to implantation of the propose project. This report should contain the following:
    a. Location – Sixth field HUC and stream name.
    b. Timing – Anticipated project start and dates.
    c. Activity Type – Identify all proposed activity types that apply.
    d. Project Description – Brief narrative of the project and objectives.
    e. Extent – Number of stream miles to be treated.
    f. Species Affected – Listed fish and or wildlife species, critical habitat, and or EFH affected by the project.

2. Project Completion Report will be provided within 120 days of project completion. This report should contain the following:
    a. Timing – Actual project start and end dates.
    b. The extent of the turbidity plume generated by any inwater construction activities.
    c. Agency contact information – Agency and project lead name.
    d. Post-project assessment – The results of the Action Agencies' post project assessment should be report to NMFS.

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 Action Agencies 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)]. This consultation expires on December 31, 2012.

Table 18. Species of fishes with designated EFH occurring in Washington and Oregon.

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. elongates*	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*

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 Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users.

This ESA consultation concludes that the proposed programmatic actions will not jeopardize the affected listed species or adversely modify or destroy designated critical habitat. Therefore, the Action Agencies can carry out these actions in accordance with their authorities under various Federal statutes. The intended users are the USDA Forest Service, USDI BLM, and USDI BIA.

Individual copies were provided to the above-listed entities. This consultation will be posted on the NMFS Northwest Region website (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

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 MSA implementing regulations regarding EFH, 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 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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Appendix 1. Analysis of Small Stream Herbicide Exposure and Salmonid Risk Potential

Appendix 1 consists of two tables containing estimates of potential herbicide concentrations resulting from application to a 10-acre area adjacent to a small stream (flow rate of 1.8 cubic feet per second), and the associated risk of adverse effects to salmonids and their habitat. The first table contains data and calculations regarding herbicide toxicity and estimated exposure levels for each herbicide. The second table contains estimates of hazard quotient (HQ) values for four species groups (salmonids, aquatic invertebrates, algae, and aquatic plants) under varying soil and annual rainfall conditions.

The first table displays acute adverse effects threshold concentrations for four species groups (salmonids, aquatic invertebrates, algae, and aquatic plants), typical and maximum herbicide application rates, herbicide water contamination rate (WCR) values, and expected instream herbicide concentrations. Adverse effect threshold concentrations are $1/20^{th}$ (for ESA listed aquatic species) or $1/10^{th}$ (all other species) of LC_{50} values, or "no observable adverse effect" concentrations, whichever concentration was lower. The WCR values are categorized by herbicide, annual rainfall level, and soil type. Variation of herbicide delivery to streams among soil types (clay, loam, and sand) is displayed as low and high WCR values. All WCR values are from risk assessments conducted by Syracuse Environmental Research Associates, and can be accessed at: http://www.fs.fed.us/foresthealth/pesticide/risk.shtml.

The second table displays HQ values for each species group by rainfall level and soil type. The rainfall levels of 15, 50, and 150 inches per year were selected to represent precipitation regimes in eastern Washington and Oregon, west-central Washington and Oregon (the Cascade mountains and western valleys), and coastal mountain ranges, respectively. The HQ values for each species group were calculated utilizing data contained in the first table. When HQ values are ≥ 1, acute adverse effects to that species group are considered likely to occur. The HQ values are highlighted in tan for exceedences ranging from 1.0 – 9.9, gold for exceedences ranging from 10 – 99, and in pink for exceedences ≥ 100.

Table 1A. Acute adverse effects threshold concentrations for four species groups (salmonids, aquatic invertebrates, algae, and aquatic plants), typical and maximum herbicide application rates, herbicide water contamination rate (WCR) values, and expected instream herbicide concentrations.

			Fish	Inverts	Algae	Aq. Plants						
	App. Rate (pounds/acre)	Precipitation Rate	Effects Threshold (mg/l)				Low WCR	soil	Lo Wa Conc (mg/l)	Hi WCR	Soil Type	Hi Wa Conc (mg/l)
Chlorsulfuron	Typical											
		15	2	10	0.01	0.000047	0.0000	loam	0.00000	0.012	clay	0.0007
	0.056	50	2	10	0.01	0.000047	0.0004	loam	0.00002	0.110	clay	0.0062
		150	2	10	0.01	0.000047	0.0040	loam	0.00022	0.200	clay	0.0112
	High											
		15	2	10	0.01	0.000047	0.0000	loam	0.00000	0.012	clay	0.0030
	0.25	50	2	10	0.01	0.000047	0.0004	loam	0.00010	0.110	clay	0.0275
		150	2	10	0.01	0.000047	0.0040	loam	0.00100	0.200	clay	0.0500
Clopyralid	Typical											
		15	5	21	0.69	0.69	0.0000	loam	0.00000	0.004	clay	0.0014
	0.35	50	5	21	0.69	0.69	0.0070	loam	0.00245	0.017	sand	0.0060
		150	5	21	0.69	0.69	0.0100	clay	0.00350	0.058	sand	0.0203
	High											
		15	5	21	0.69	0.69	0.0000	loam	0.00000	0.004	clay	0.0020
	0.5	50	5	21	0.69	0.69	0.0070	loam	0.00350	0.017	sand	0.0085
		150	5	21	0.69	0.69	0.0100	clay	0.00500	0.058	sand	0.0290
Glyphosate	Typical											
		15	0.5	78	0.89	3	0.0011	clay	0.00220	0.006	sand	0.0120
	2	50	0.5	78	0.89	3	0.0180	clay	0.03600	0.056	sand	0.1120
		150	0.5	78	0.89	3	0.0924	clay	0.18480	0.227	sand	0.4540
	High											
		15	0.5	78	0.89	3	0.0011	clay	0.00880	0.006	sand	0.0480
	8	50	0.5	78	0.89	3	0.0180	clay	0.14400	0.056	sand	0.4480
		150	0.5	78	0.89	3	0.0924	clay	0.73920	0.227	sand	1.8160
Imazapyr	Typical											
		15	5	100	0.02	0.013	0.00000	loam	0.00000	0.00005	clay	0.0000
	0.45	50	5	100	0.02	0.013	0.00000	loam	0.00000	0.0006	clay	0.0003
		150	5	100	0.02	0.013	0.00010	loam	0.00005	0.017	clay	0.0077
	High											
		15	5	100	0.02	0.013	0.00000	loam	0.00000	0.00005	clay	0.0001
	1.5	50	5	100	0.02	0.013	0.00000	loam	0.00000	0.0006	clay	0.0009
		150	5	100	0.02	0.013	0.00010	loam	0.00015	0.017	clay	0.0255
Metsulfuron	Typical											
		15	4.50	17.00	0.01	0.00016	0.00000	loam	0.00000	0.0001	clay	0.0000
	0.03	50	4.50	17.00	0.01	0.00016	0.00005	loam	0.00000	0.0011	clay	0.0000
		150	4.50	17.00	0.01	0.00016	0.00010	loam	0.00000	0.0020	clay	0.0001
	High											
		15	4.50	17.00	0.01	0.00016	0.00000	loam	0.00000	0.0001	clay	0.0000
	0.15	50	4.50	17.00	0.01	0.00016	0.00005	loam	0.00001	0.0011	clay	0.0002
		150	4.50	17.00	0.01	0.00016	0.00010	loam	0.00002	0.0020	clay	0.0003
Sethoxydim	Typical											
		15	0.06	0.26	0.25	0.25	0.00462	clay	0.00139	0.0198	sand	0.0059
	0.3	50	0.06	0.26	0.25	0.25	0.05490	clay	0.01647	0.1280	loam	0.0384
		150	0.06	0.26	0.25	0.25	0.22600	sand	0.06780	0.4060	loam	0.1218
	High											
		15	0.06	0.26	0.25	0.25	0.00462	clay	0.00208	0.0198	sand	0.0089
	0.45	50	0.06	0.26	0.25	0.25	0.05490	clay	0.02471	0.1280	loam	0.0576
		150	0.06	0.26	0.25	0.25	0.22600	sand	0.10170	0.4060	loam	0.1827
Sulfometuron	Typical											
		15	4.5	6.1	0.0025	0.00021	0.00000	loam	0.00000	0.0001	clay	0.0000
	0.03	50	4.5	6.1	0.0025	0.00021	0.00000	loam	0.00000	0.0008	clay	0.0000
		150	4.5	6.1	0.0025	0.00021	0.00005	loam	0.00000	0.0021	clay	0.0001
	High											
		15	4.5	6.1	0.0025	0.00021	0.00000	loam	0.00000	0.0001	clay	0.0000
	0.38	50	4.5	6.1	0.0025	0.00021	0.00000	loam	0.00000	0.0008	clay	0.0003
		150	4.5	6.1	0.0025	0.00021	0.00005	loam	0.00002	0.0021	clay	0.0008

Table 2A. HQ values for each species group by rainfall level and soil type

Hazard Quotient values (HQ) for lowest and highest peak Water Contamination Rates (WCR) for typical and maximum application rates at annual rainfall rates of 15, 50, and 150 inches

Species Group	Annual Rainfall	Application Rate	Chlorsulfuron				Clopyralid				Glyphosate (aquatic)				Imazapyr			
			Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type
Fish	15	Typical	0.00000	loam	0.0003	clay	0.00000	loam	0.0003	clay	0.004	clay	0.02	sand	0.00000	loam	0.00000	clay
		Maximum	0.00000		0.002		0.00000		0.0004		0.02		0.1		0.00000		0.00002	
	50	Typical	0.00001	loam	0.003	clay	0.0005	loam	0.001	sand	0.07	clay	0.2	sand	0.00000	loam	0.0001	clay
		Maximum	0.00005		0.01		0.0007		0.002		0.3		0.9		0.00000		0.0002	
	150	Typical	0.0001	loam	0.006	clay	0.0007	clay	0.004	sand	0.4	clay	0.9	sand	0.00001	loam	0.002	clay
		Maximum	0.0005		0.03		0.001		0.01		1.5		3.6		0.00003		0.01	
Aquatic Invertebrates	15	Typical	0.00000	loam	0.00007	clay	0.00000	loam	0.00007	clay	0.00003	clay	0.0002	sand	0.00000	loam	0.00000	clay
		Maximum	0.00000		0.0003		0.00000		0.0001		0.0001		0.0006		0.00000		0.00000	
	50	Typical	0.00000	loam	0.001	clay	0.0001	loam	0.0003	sand	0.0005	clay	0.001	sand	0.00000	loam	0.00000	clay
		Maximum	0.00001		0.003		0.0002		0.0004		0.002		0.006		0.00000		0.00001	
	150	Typical	0.00002	loam	0.001	clay	0.0002	clay	0.001	sand	0.002	clay	0.006	sand	0.00000	loam	0.00008	clay
		Maximum	0.0001		0.005		0.0002		0.001		0.009		0.02		0.00000		0.0003	
Algae	15	Typical	0.00000	loam	0.07	clay	0.00000	loam	0.002	clay	0.002	clay	0.01	sand	0.00000	loam	0.001	clay
		Maximum	0.00000		0.3		0.00000		0.003		0.01		0.05		0.00000		0.004	
	50	Typical	0.002	loam	0.6	clay	0.00	loam	0.009	sand	0.04	clay	0.1	sand	0.00007	loam	0.01	clay
		Maximum	0.01		2.8		0.01		0.01		0.2		0.5		0.0002		0.05	
	150	Typical	0.02	loam	1.1	clay	0.01	clay	0.03	sand	0.2	clay	0.5	sand	0.002	loam	0.4	clay
		Maximum	0.1		5.0		0.01		0.04		0.8		2.0		0.008		1.3	
Aquatic Macrophytes	15	Typical	0.00000	loam	14	clay	0.00000	loam	0.002	clay	0.0007	clay	0.004	sand	0.00000	loam	0.002	clay
		Maximum	0.00000		64		0.00000		0.003		0.003		0.02		0.00000		0.006	
	50	Typical	0.5	loam	131	clay	0.00	loam	0.03	sand	0.01	clay	0.04	sand	0.0001	loam	0.02	clay
		Maximum	2.1		585		0.01		0.01		0.05		0.1		0.0003		0.07	
	150	Typical	4.8	loam	238	clay	0.01	clay	0.03	sand	0.06	clay	0.2	sand	0.003	loam	0.6	clay
		Maximum	21		1064		0.01		0.04		0.2		0.6		0.01		2.0	

Species Group	Annual Rainfall	Application Rate	Metsulfuron				Sethoxydim				Sulfometuron			
			Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type
Fish	15	Typical	0.00000	loam	0.00000	clay	0.02	clay	0.1	sand	0.00000	loam	0.00000	clay
		Maximum	0.00000		0.00000		0.03		0.1		0.00000		0.00001	
	50	Typical	0.00000	loam	0.00000	clay	0.3	clay	0.6	loam	0.00000	loam	0.00001	clay
		Maximum	0.00000		0.00004		0.4		1.0		0.00000		0.00007	
	150	Typical	0.00000	loam	0.00000	clay	1.1	sand	2.0	loam	0.00000	loam	0.00001	clay
		Maximum	0.00000		0.00007		1.7		3.0		0.00000		0.0002	
Aquatic Invertebrates	15	Typical	0.00000	loam	0.00000	clay	0.005	clay	0.02	sand	0.00000	loam	0.00000	clay
		Maximum	0.00000		0.00000		0.008		0.03		0.00000		0.00000	
	50	Typical	0.00000	loam	0.00000	clay	0.06	clay	0.1	loam	0.00000	loam	0.00000	clay
		Maximum	0.00000		0.00001		0.10		0.2		0.00000		0.00005	
	150	Typical	0.00000	loam	0.00000	clay	0.3	sand	0.5	loam	0.00000	loam	0.00001	clay
		Maximum	0.00000		0.00002		0.4		0.7		0.00000		0.00013	
Algae	15	Typical	0.00000	loam	0.0004	clay	0.006	clay	0.02	sand	0.00000	loam	0.0008	clay
		Maximum	0.00000		0.002		0.008		0.04		0.00000		0.01	
	50	Typical	0.0002	loam	0.003	clay	0.07	clay	0.2	loam	0.00001	loam	0.01	clay
		Maximum	0.0008		0.02		0.1		0.2		0.0002		0.1	
	150	Typical	0.0003	loam	0.006	clay	0.3	sand	0.5	loam	0.0006	loam	0.03	clay
		Maximum	0.002		0.03		0.4		0.7		0.007		0.3	
Aquatic Macrophytes	15	Typical	0.00000	loam	0.02	clay	0.006	clay	0.02	sand	0.00000	loam	0.01	clay
		Maximum	0.00000		0.1		0.008		0.04		0.00000		0.1	
	50	Typical	0.009	loam	0.2	clay	0.07	clay	0.2	loam	0.0001	loam	0.1	clay
		Maximum	0.05		1.0		0.1		0.2		0.002		1.4	
	150	Typical	0.02	loam	0.4	clay	0.3	sand	0.5	loam	0.007	loam	0.3	clay
		Maximum	0.09		1.9		0.4		0.7		0.08		3.8	