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 Tracking No:
F/NWR/2007/01096

January 4, 2008

Claire Lavendel, Forest Supervisor
Gifford Pinchot National Forest
U.S.D.A. Forest Service
10600 N.E. 51st Circle
Vancouver, Washington 98682

Daniel T. Harkenrider
Scenic Area Manager
Columbia River Gorge National Scenic Area
902 Wasco Street, Suite 200
Hood River, Oregon 97031

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area Invasive Plant Treatment Project, Thurston, Pierce, Lewis, Cowlitz, Skamania, Clark, Klickitat, and Yakima Counties, Washington (5th Field HUCs 1707010501, 1707010504, 1707010509, 1707010512, 1707010604, 1708000107, 1708000108, 1708000205, 1708000401, 1708000402, 1708000403, 1708000404, 1708000405, 1708000501, 1708000502, 1708000504,1708000505, 1708000506)

Dear Ms. Lavendel and Mr. Hom:

The enclosed document contains a biological opinion prepared by the National Marine Fisheries Service pursuant to section 7(a)(2) of the Endangered Species Act on the effects of the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area Invasive Plant Treatment Project for January 1, 2008, through December 31, 2013. The program covers more than 1,968,864 acres on the Gifford Pinchot National Forest and the Columbia River Gorge National Scenic Area and contains more than 10,330 acres on the Gifford Pinchot National Forest and 1,116 acres on the Columbia River Gorge National Scenic Area of inventoried weed infestations requiring treatment. In addition, the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area are anticipating continuing the invasive plant treatment program for up to fifteen years, for which the National Marine Fisheries Service is consulting on five years. In the biological opinion, National Marine Fisheries Service concludes that the action, as proposed, is not likely to jeopardize the continued existence of threatened Lower Columbia River Chinook salmon Snake River spring/summer run Chinook salmon, Snake River fall run Chinook salmon,

Lower Columbia River steelhead, Middle Columbia River steelhead, Snake River basin steelhead, Columbia River chum salmon, Lower Columbia River coho salmon, and endangered Upper Columbia River spring-run Chinook salmon, Upper Columbia River steelhead, and Snake River sockeye salmon, In addition, National Marine Fisheries Service concludes that the action, as proposed, is not likely to result in the destruction or adverse modification of designated critical habitat for all of the above species except Lower Columbia River coho salmon.

As required by section 7 of the Endangered Species Act, the National Marine Fisheries Service provided an incidental take statement with the biological opinion. The incidental take statement describes reasonable and prudent measures that the National Marine Fisheries Service considers necessary or appropriate to minimize incidental take associated with this action. The incidental take statement also sets forth nondiscretionary terms and conditions, including reporting requirements, that the Federal agency and any person who performs the action must comply with to carry out the reasonable and prudent measures. Incidental take from actions by the action agency and applicant that meets these terms and conditions will be exempt from the Endangered Species Act take prohibition.

This document also includes the results of National Marine Fisheries Service analysis of the action's likely effects on essential fish habitat pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act, and includes four Conservation Recommendations to avoid, minimize, or otherwise offset potential adverse effects on essential fish habitat. These Conservation Recommendations are an identical set of the Endangered Species Act Terms and Conditions. Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act requires Federal agencies provide a detailed written response to the National Marine Fisheries Service within 30 days after receiving these recommendations.

If the response is inconsistent with the essential fish habitat recommendations, the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall essential fish habitat program effectiveness by the Office of Management and Budget, the National Marine Fisheries Service established a quarterly reporting requirement to determine how many Conservation Recommendations are provided as part of each essential fish habitat consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the essential fish habitat 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 Rachel Friedman, Washington State Habitat Office (360) 753-4063.

Sincerely,

for

D. Robert Lohn
Regional Administrator

cc: Diana Perez, Gifford Pinchot National Forest
Vince Harke, U.S. Fish and Wildlife Service, Olympia

Endangered Species Act – Section 7 Programmatic Consultation Biological and Conference Opinion And Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

Invasive Plant Treatment Project – Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area

Lead Action Agencies:	United States Department of Agriculture Forest Service
Consultation Conducted By:	National Marine Fisheries Service Northwest Region
Date Issued:	January 4, 2008
Issued by:	D. Robert Lohn Regional Administrator
NMFS Tracking No.:	2007/01096

ACRONYM GLOSSARY

A.I.	Active Ingredient
APHIS	Agriculture Plant Health Inspection Service
ATV	All Terrain Vehicle
BA	Biological Assessment
C	Centigrade
CC	Columbia River chum salmon
CFS	Cubic Feet per Second
CHARTS	Critical Habitat Analytical Review Teams
CI	Confidence Intervals
CIRS	Consultation Initiation and Reporting System
CRGNSA	Columbia River Gorge National Scenic Area
DEIS	Draft Environmental Impact Statement
DN	Decision Notes
DPS	Distinct Population Segment
DQA	Data Quality Act
Ecology	Department of Ecology
EDRR	Early Detection/Rapid Response
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
F	Fahrenheit
FACTS	Forest Service Activity Tracking System
FEMAT	Forest Ecosystem Management Assessment Team
FEIS	Final Environmental Impact Statement
FS	Forest Service
GIS	Geographical Information Survey
GPNF	Gifford Pinchot National Forest
HQ	Hazard Quotient
ITS	Incidental Take Statement
IWM	Integrated Weed Management
IWMPEA	Integrated Weed Management Program Environmental Assessment
LCC	Lower Columbia River Chinook salmon
LCRC	Lower Columbia River coho salmon
LCS	Lower Columbia River steelhead
LOAEL	Lowest Observed Adverse Effect Level
LRMP	Land and Resource Management Plan
LWD	Large Woody Debris
MCS	Middle Columbia River steelhead
MM	Millimeter
MPG	Major Population Group
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act

NF	North Fork
NMFS	National Marine Fisheries Service
NOAEC	No Observed Adverse Effect Concentration
NOEC	No Observed Effect Concentration
NOS	National-Origin Spawners
NPE	Nonyl Phenol Ethoxylate
NPS	National Park Service
NRIS	Natural Resource Information System
NTU	National Turbidity Units
NWFP	Northwest Forest Plan
Opinion	Biological Opinion
PCB	PolyChlorinated Biphenyls
PCE	Primary Constituent Element
PCEF	Project Consistency Evaluation Form
PDC	Project Design Criteria
PFMC	Pacific Fishery Management Council
PPB	Parts Per Billion
PPM	Parts Per Million
RKm	River Kilometer
RM	River Mile
RPMs	Reasonable and Prudent Measures
ROD	Record of Decision
SBS	Snake River basin steelhead
SERA	Syracruse Environmental Research Associates
SRS	Snake River sockeye salmon
SFC	Snake River fall run Chinook salmon
SSC	Snake River spring/summer run Chinook salmon
TA	Treatment Area
TRT	Technical Recovery Team
UCS	Upper Columbia River steelhead
UCSC	Upper Columbia River spring-run Chinook salmon
USFWS	United States Fish and Wildlife Service
VSP	Viable Salmonid Populations
WCR	Water Contamination Rate
WSDA	Washington State Department of Agriculture
WSHO	Washington State Habitat Office

INTRODUCTION

This document contains a biological opinion (Opinion) and incidental take statement 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 NMFS Northwest Region Habitat Conservation Division, Washington Habitat State Office, Lacey, Washington.

Background and Consultation History

The United States Forest Service, Gifford Pinchot National Forest (GPNF) and Columbia River Gorge National Scenic Area (CRGNSA) propose to carry out a program to control the spread of noxious weeds and non-native invasive plants throughout the forest and scenic area. The purpose of the program is to suppress, contain, control and/or eradicate invasive plants, including those that are currently known and, within specified parameters, those discovered in the future, in a cost-effective manner that complies with environmental standards over the next 5 to 15 years (until the invasive plant objectives are met or until changed conditions or new information warrants the need for a new decision).

The program will occur throughout lands administered by the U.S. Forest Service (FS) in the GPNF and CRGNSA. Those lands include 1,358,000 acres on the GPNF and the approximately 85,000 acres on the northern portion of the CRGNSA. The following fifth field watersheds contain listed fish: Wind River, Washougal River, East Fork Lewis River, Clearfork Cowlitz River, Upper Cowlitz River, Middle Cowlitz River, Upper Cispus River, Riffe Reservoir Cispus River, Tilton River, North Fork Toutle River, Green River, South Fork Toutle River, Upper Columbia River/Hood, Middle Columbia/Grays Creek, Lower Klickitat River, and Columbia Gorge tributaries.

Weed control mechanisms in the proposed action include the integrated use of herbicides, mechanical, and manual treatments, as well as restoration actions. Herbicide treatments are limited to formulations including carriers, surfactants, and other additives applied in application methods described and analyzed in the Biological Assessment (BA) prepared to initiate this consultation, and the draft environmental impact statement (2006 GP/CRGNSA DEIS), which has been prepared by the FS to assess the environmental effects of the proposed action and various alternative invasive plant programs (USDA 2006).

The GPNF and CRGNSA are proposing the action according to its authority under the Executive Order 13112 (1999) that directs Federal agencies to reduce the spread of invasive plants. The FS Pesticide Use Handbook (FSH 2109.14) provides the agency guidance on planning, implementation and reporting of projects that include herbicides.

The proposed action is derived from several prior environmental analyses. In 2005, the FS prepared a regional-level environmental impact statement, the Pacific Northwest Region Final Environmental Impact Statement (R6 2005 FEIS) (USDA 2005c), which examined the environmental effects of various alternative invasive species control programs in the Forests in the states of Washington and Oregon. The FS subsequently prepared a BA examining the effects of the proposed programs on listed species (R6 2005 BA), (USDA 2005a), and consulted with NMFS, which issued a Biological Opinion (R6 2005 BiOp, NMFS 2005b) finding that the proposed action was not likely to jeopardize the continued existence of any of the listed ESUs, or was not likely to destroy or adversely modify designated critical habitats. The FS then issued a 2005 Record of Decision (R6 2005b ROD) selecting its preferred alternative for carrying out its responsibilities under EO 13112.

The proposed action under consideration here applies the R6 2005 ROD specifically to the GPNF and CRGNSA. The project-level analysis in the 2006 GPNF and CRGNSA DEIS tiers from the broader scale analysis in the R6 2005 FEIS (USDA 2005c) and ROD (USDA 2005b), which amended the GPNF and CRGNSA Plan by adding management direction for preventing and treating invasive plant infestations. Land uses and activities, including the proposed action, are designed to comply with the standards set forth in the R6 2005 ROD.

On August 8, 2005, the FS, representing the GPNF and CRGNSA, initiated informal discussions with NMFS, Washington State Habitat Office and U.S. Fish and Wildlife Service (USFWS) regarding the effects of implementing the proposed program, which includes plans for the treatment of identified problem sites as well as a program for identifying and treating presently undiscovered sites and sites where invasive species may spread in the future. The latter program is referred to as the "Early Detection/Rapid Response" (EDRR) program of invasive plant treatment. Between August 8, 2005 and January 19, 2007, numerous meetings and conference calls of both the Level 1 and Level 2 teams of staff and managers occurred, and numerous versions of the draft BA and 2006 GPNF/CRGNSA DEIS were reviewed. On January 19, 2007, the GPNF and CRGNSA sent NMFS a final BA and written request and for ESA section 7 formal consultation on site-specific treatments and the EDRR program, as well as essential fish habitat (EFH) consultation pursuant to the Magnuson-Stevens Fishery Conservation and Management Act.

In addition, on January 19, 2007, the GPNF and CRGNSA sent NMFS a written request for ESA section 7 informal consultation on a subset of the site-specific treatments. While NMFS agrees with the criteria used to define site-specific treatments that are "not likely to adversely affect" listed species or their critical habitat, differentiation of site-specific treatments will not occur during this consultation. All site-specific treatments will be covered under this formal consultation.

Description of the Proposed Action

This formal consultation covers the GPNF's and CRGNSA's proposed program for responding to existing and new infestations of invasive plants with a variety of treatment methods appropriate to a range of site conditions found on the forest and scenic area. The proposed GPNF and CRGNSA programs are considered in detail in the 2006 GPNF/CRGNSA DEIS which is tiered from the R6 2005 FEIS.

The GPNF and CRGNSA will use the treatment methods and prescriptions described below. The management techniques include integrated use of herbicides, mechanical, and manual treatments, as well as restoration actions. Infested areas would be treated with an initial prescription and retreated in subsequent years until the site was restored with desirable vegetation. Herbicide application would likely be part of the treatment prescription for all known sites; however, use of herbicides would be expected to decline in subsequent treatments as invasive plant populations would be expected to decrease to the point where herbicide would no longer be needed. Mechanical and manual treatments would occur either in concert with herbicide applications or separately. Mechanical and manual treatments are useful in limited circumstances so their use would not likely be widespread. Ongoing inventories would confirm the location of specific invasive plants and effectiveness of past treatments. Restoration would occur once the infestation had reached the target size.

Approximately 2,710 acres are currently estimated to need treatment, including but not limited to knapweeds, knotweeds, and reed canarygrass.

The proposed action consists of two components. First, the program calls for the treatment of existing, identified infestations. Existing areas of infestation on the GPNF and CRGNSA are catalogued in a 2004 Data Base and are included as tables in Appendix B1 and B2. Vectors of invasive plant spread were surveyed in the field and the results were documented in the data base. One hundred and ten treatment areas were mapped throughout the forest and scenic area. Treatment areas are defined as geographic assemblages of inventoried and anecdotal invasive plant sites based on current infestations and predicted vectors of spread. Estimated treatment acreage is based on the November 2004 Data Base and anecdotal information, modified to account for predictable rates of spread. Within the treatment areas, about 2710 acres (2,350 acres GPNF and 360 acres CRGNSA) have been identified as needing treatment under the proposed action. The majority of the infestations on the GPNF are along roadsides (2,000 acres), and in clearings, fields, grasslands, and recreational areas on the CRGNSA (342 acres).

The second component of the proposed action is a program for identifying and treating existing but previously undocumented infestations as well as infestations that arise in the future. This is referred to as the EDRR program. The GPNF and CRGNSA propose to allow for treatment "within the scope of the EIS" (that is the final version of the 2006 GPNF and CRGNSA DEIS) of new, or presently unidentified infestations found over the next five to fifteen years.

For unidentified infestations and infestations discovered in the future, the GPNF and CRGNSA will use the EDRR program, consisting of the range of methods described below. The EDRR approach enables the GPNF and CRGNSA to learn of and respond to infestations far more efficiently than has occurred in the past. The intent of the EDRR approach is to treat new infestations when they are small so that any adverse treatment effects are minimized. The approach is based on the fact that the impacts of similar treatments are predictable and treatments can therefore be prescribed in advance with reasonable assurance as to what the environmental effects will be. To ensure the actions and their environmental results remain predictable and prescribable, the proposed action limits the spatial and temporal application of the EDRR program. For invasive plant sites above bankfull, within the aquatic influence zone, treatments would not exceed 10 acres along any 1.5 miles of stream reach within a sixth field subwatershed[1] in any given year. In addition, for invasive plant sites below bankfull, treatments would not exceed a total of seven[2] acres within a sixth field sub-watershed in any given year.

The Implementation Planning Process (described below) ensures that treatment treatments will be within the scope of those analyzed in this consultation. New situations that may have different treatment needs would be beyond the scope of this consultation and subject to further ESA review.

The GPNF and CRGNSA have identified numerous invasive species that are targeted for treatment under the proposed action and has also identified a number of Project Design Criteria (PDCs) that will be employed on a site-specific basis to minimize the potential for adverse effects from treatments. The Common Control Measures, described in Table 1 below, are the starting point for the development of site-specific prescriptions, which will be refined for specific sites according to the PDCs.

Some control measures listed in Table 1 may not be available in some locations due to the PDCs (for instance, broadcast treatment of any herbicide within 100 feet of a live stream). The Common Control Measures would be applied to site-specific conditions as part of the Implementation Planning Process.

Many of the target species may grow in riparian areas. A few, such as knotweed, reed canary grass, purple loosestrife, and the thistles tend to be associated with meadows, wetlands, and streams.

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[1] Using a hierarchical structure, the U.S. Geologic Survey developed the term "sixth-field watershed" to denote subsystems of large riverine drainage areas.

[2] The biological relevance of the EDRR program delimiters stems from the use of 10 acres as the hypothetical site used to model the risks from the use of herbicides, and the fact that the largest known site with emergent vegetation on the GPNF/CRGNSA is seven acres large.

Table 1. Common Control Measures by Target Species

Target Species – Common and *Scientific Names* and Growth Habit	Estimated Treatment Acres from 2004 Data Base	Documented Effective Herbicides	When/How to treat with Herbicides	Integrated Control Measures
Spotted knapweed (*Centaurea biebersteinii*) **Diffuse knapweed (*Centaurea diffusa*)** **Meadow knapweed (*Centaurea debeauxii*)** **Brownray knapweed (*Centaurea jacea*)** **Biennial or perennial**	696 (GPNF) 133 (CRGNSA)	Upland: A - Clopyralid, B - Picloram Areas having risk of herbicide delivery to surface waters /High Water Table/Porous Soils: Aquatic labeled Glyphosate	Roadsides: Broadcast spray in dense cover or where dominant plant community is non-native. Otherwise, spot spray on smaller, less dense, patchy roadside infestations. Follow PDC: they may require a less impacting treatment choice. Non-roadside sites: Spot or hand treat. Treat in spring before bud stage. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seed bank.	- Hand pull or dig small populations or when volunteer labor is available. Multiple treatments per year are required. - Manual Disposal: Remove entire root system from the site, as re-growth can occur. -Mowing is possible, but timing is critical. - Manual treatments may take up to ten years due to long term seed viability. - Revegetate with desirable species in accordance with the Restoration Plan.

Target Species – Common and *Scientific Names* and Growth Habit	**Estimated Treatment Acres from 2004 Data Base**	**Documented Effective Herbicides**	**When/How to treat with Herbicides**	**Integrated Control Measures**
Yellow star thistle (*Centaurea solstitialis*) **Annual**	286 (CRGNSA)	Upland: A - Clopyralid, B - Picloram Areas having risk of herbicide delivery to surface waters /High Water Table/Porous Soils: Aquatic labeled Glyphosate	Roadsides: Broadcast spray in dense or continuous target vegetation or where dominant plant community is non-native. Otherwise, spot spray on smaller, less dense, patchy roadside infestations. Follow PDC: they may require a less impacting treatment choice. Non-roadside sites: Spot or hand treat. Treat in spring before bud stage. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Manual removal is most effective with small patches or where plants are sporadically located. Best time for manual removal is after the plants have bolted and before they produce viable seed. It is important to detach all above ground stem material. Leaving even a two inch piece of stem can result in re-growth if leaves and buds are still attached at the base of the plant. - For large populations, remove plants at the outward edge, working in towards the interior. - Manual Disposal: Remove all flower heads (at any stage of maturity) from site. - Mowing is possible, but timing is critical. Plants must be developed to where the stem branches are above the mowing height, otherwise flowers might still develop. -Manual treatments may take up to ten years due to long term seed viability. - Revegetate with desirable species in accordance with the Restoration Plan.
Japanese knotweed (*Polygonum cuspidatum*) **Perennial**	12 (GPNF) 2 (CRGNSA)	Upland: A - Glyphosate, B - Triclopyr Areas having risk of herbicide delivery to surface waters: A - Aquatic labeled Glyphosate, B - Aquatic labeled Triclopyr, C- Aquatic labeled Imazapyr	Stems > 3/4": Stem injection; Stems< 3/4": Stem injection or Foliar spray Treat June through September Stem injection may require one or more revisits, and foliar spray may require at least one, depending on the seed bank.	- Herbicide treatment most effective. Use stem injection or foliar spray. Dead canes can be left. - Some manual removal possible for small infestation (1-5 plants). - Manual Disposal: Remove all plant parts from site, as stems and rhizomes can bud into new individuals. - Revegetate with desirable species if surrounding cover is primarily non-native, in accordance with the Restoration Plan.

Target Species – Common and *Scientific Names* and Growth Habit	Estimated Treatment Acres from 2004 Data Base	Documented Effective Herbicides	When/How to treat with Herbicides	Integrated Control Measures
Hawkweed (*Hieracium pratense*) **Perennial**	38 (GPNF)	Upland: A - Clopyralid, B - Picloram Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate	Spot spray whenever possible. Broadcast spray in areas of dense cover or where dominant plant community is non-native. Follow PDC: they may require a less impacting treatment choice. Treat in spring after most basal leaves emerge but before buds form. Fall treatment may also be effective, but research is limited. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Herbicide treatment is most effective. - Some manual removal possible for small infestations. - Manual Disposal: All plant parts should be removed, as new plants can bud from root, stolon, and rhizome fragments. -Covering with a plastic tarp may also work for small infestations. - Nitrogen fertilization after treatment would encourage native plant growth if done in the spring. - Revegetate with desirable species in accordance with the Restoration Plan (see Section 2.5.4).
Butter 'n' eggs (*Linaria vulgaris*) **Toadflax *(Linaria sp.)*** **Perennial**	4 (GPNF)	Upland Forested: Metsulfuron methyl In native grasses: Imazapic (in fall only) Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate	Broadcast spray would generally not be necessary: this species tends to be scattered. Apply during active growth in spring before bloom or in late summer or fall during re-growth. Revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. This control could vary by site. Even after three years of consecutive treatments, control may range widely.	- Hand pull or dig small populations or volunteer labor is available. -Manual Disposal: Plants can be left on site, but may reduce germination of desirable species due to mulching effect. If plants have flower heads with seeds (immature as well), bag and remove them from site. -Cutting stems in spring or early summer would eliminate plant reproduction, but not the infestation. - These treatments may take up to ten years due to long term seed viability. - Revegetate with desirable species in accordance with the Restoration Plan. Plant communities in good condition may recover without replanting.

Target Species – Common and *Scientific Names* and Growth Habit	**Estimated Treatment Acres from 2004 Data Base**	**Documented Effective Herbicides**	**When/How to treat with Herbicides**	**Integrated Control Measures**
Houndstongue (*Cynoglossum officinale*) **Perennial**	45 (GPNF)	Forested: Metsulfuron methyl In native grasses: Imazapic Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate	Roadsides: Broadcast spray in dense cover or where dominant plant community is non-native. Otherwise, spot spray on smaller, less dense, patchy roadside infestations. Large non-sensitive sites: ATV Broadcast spray Follow PDC: they may require a less impacting treatment choice. Apply during active growth, preferably basal rosette stage. Revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Hand pull or dig small populations. - Manual Disposal: Entire root system must be removed. Plants could be left on site if no seed pods are present (seed can remain viable for more than one year). - Manual treatments may take up to five years. - Revegetate with desirable species in accordance with the Restoration Plan.
Scotch broom (*Cytisus scoparius*) **False Indigo (Amorpha fruticosa)** **Perennial**	780 (GPNF) 58 (CRGNSA)	Upland: A -Triclopyr B - Clopyralid C - Picloram Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate	Larger plants: Cut and paint. Smaller plants: Spot spray where hand-pulling or weed wrenching is not feasible. Apply during active growth preferably in the spring to young plants. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Hand pulling, cutting, weed wrenching or digging of small populations or when volunteer labor is available. Hand-pulling or weed wrenching is most effective in moist soils. Cutting would require multiple visits in one year. -Manual Disposal: Plants can be left on site if no seed pods are present (seed can remain viable for several years). - Manual treatments may take up to ten years due to long term seed viability. - Revegetate with desirable species in accordance with the Restoration Plan.

Target Species – Common and *Scientific Names* and Growth Habit	**Estimated Treatment Acres from 2004 Data Base**	**Documented Effective Herbicides**	**When/How to treat with Herbicides**	**Integrated Control Measures**
Puncturevine ***(Tribulus terrestris)*** **Annual**	1 (CRGNSA)	Upland: A – Metsulfuron methyl B – Imazapic (if native grasses are present) C – Chlorsulfuron Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate	Spot spray whenever possible. Broadcast spray in areas of dense cover or where dominant plant community is non-native.) Follow PDC: they may require a less impacting treatment choice. Apply herbicide in early spring during active growth. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Handpulling is as effective as chemical control. - Manual Disposal: If flowering, remove plants from site. - Manual treatments may take up to ten years due to long term seed viability. - Mowing is ineffective due to the prostrate growth habit. - Revegetate with desirable species in accordance with the Restoration Plan.
Mat Sandbur **(*Cenchrus longispinus)*** **Annual**	1 (CRGNSA)	Upland: A - Glyphosate Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate	Spot spray whenever possible. Broadcast spray in areas of dense cover or where dominant plant community is non-native. Follow PDC: they may require a less impacting treatment choice. Apply herbicide in early spring during active growth. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Digging or pulling before flowering is effective, and may take up to ten years due to long term seed viability. - Manual Disposal: If flowering, remove plants from site. - Mowing is ineffective as plant (grass) would re-grow and produce seed. -If chemical treatment is not an option, repeated mowing (every three weeks) is necessary and may still not be effective. Bag and remove cut material. - Revegetate with desirable species in accordance with the Restoration Plan.

Target Species – Common and *Scientific Names* and Growth Habit	Estimated Treatment Acres from 2004 Data Base	Documented Effective Herbicides	When/How to treat with Herbicides	Integrated Control Measures
Reed canarygrass (*Phalaris arundinaceae*) **Perennial**	10 (GPNF) 3 (CRGNSA)	Upland: Sulfometuron methyl (highly unlikely the site would be upland) Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate	Hand wipe or spot spray whenever possible. Broadcast spray in dense cover or where dominant plant community is non-native. Follow PDC: they may require a less impacting treatment choice. Apply in early spring when just sprouting before other wetland species have emerged. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Use a combination of herbicides and manual, mechanical, or cultural treatments. Manual treatments or mowing are only practical for small stands when multiple treatments per year can be made. The entire population must be removed 2 to 3 times per year for at least five years. -Manual Disposal: As reed canary grass can regenerate from short pieces of rhizome, remove all plant parts from site. - Covering populations with black plastic may be effective if shoots are not allowed to grow beyond tarps. This technique could take over two years to be effective.
Canada thistle (*Cirsium arvense*) **Perennial** **sowthistle (*Sonchus arvensis*)** **Perennial**	426 (GPNF) 135 (CRGNSA)	Upland: A - Clopyralid B – Picloram C – Chlorsulfuron Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate (best in fall)	Broadcast spray in dense cover or where dominant plant community is non-native. Spot spray whenever possible. Follow PDC: they may require a less impacting treatment choice. Apply in spring to rosettes and prior to flowering. Or apply in fall to rosettes; season is dependent upon herbicide used. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Herbicide treatment is most effective. - The only manual technique would be hand cutting of flower heads, which only suppresses seed production. -Manual Disposal: bag and remove flower heads form site. -Mowing may be effective in rare cases if done monthly (this intensity would damage native species). -Covering with a plastic tarp may also work for small infestations. - Revegetate with desirable species in accordance with the Restoration Plan.

Target Species – Common and *Scientific Names* and Growth Habit	**Estimated Treatment Acres from 2004 Data Base**	**Documented Effective Herbicides**	**When/How to treat with Herbicides**	**Integrated Control Measures**
Herb robert (*Geranium robertianum)* **Annual, Biennial or Perennial**	31 (GPNF)	Glyphosate	On large, dense infestations: broadcast spray; on small, scattered infestations: spot spray. Herbicide application most effective in the early spring. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Hand-pulling is most effective if the entire plant is pulled. -Manual Disposal: Plant can be left on site, if not in flower. If in flower, bag and remove. - Care must be taken not to pull desirable vegetation which is usually intermingled.
Purple loosestrife (*Lythrum salicaria*) **Perennial**	2 (GPNF)	Aquatic labeled Glyphosate	Larger stems: Cut and paint high up stem under inflorescence. A glove technique for hand wiping could be used. Wick up the top 1/3 of plant after flower heads are removed. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Herbicide treatment is most effective. - Hand removal of small populations or isolated stems is possible, but only if entire rootstock is removed. -Manual Disposal: All plant parts must be removed from site, as broken off pieces can re-root. - The only other technique would be hand cutting of flower heads, which only suppresses seed production. - Revegetate with desirable species in accordance with the Restoration Plan.
Himalayan blackberry (*Rubus discolor*) **Perennial (canes die off annually)**	35 (GPNF) 162 (CRGNSA)	Uplands: Triclopyr Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate	Cut and paint larger canes. Broadcast spray is possible after canes are cut if non-targets are not an issue. Spot spray whenever possible. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Use a combination of herbicides and manual and/or mechanical treatments. Usually mechanical removal of large biomass in the summer (using a mower, or brush hog), followed by manual removal of resprouting canes and roots, then herbicide treatment of new growth in the fall/winter is most effective. The massive root crown must be fully dug out at some point if using only manual/mechanical techniques. The cultural technique of grazing with goats is also a technique proving successful if goats can be confined to the blackberry area. - Revegetate with desirable species in accordance with the Restoration Plan.

Target Species – Common and *Scientific Names* and Growth Habit	Estimated Treatment Acres from 2004 Data Base	Documented Effective Herbicides	When/How to treat with Herbicides	Integrated Control Measures
Butterfly bush (*Buddleja* sp.) **Perennial**	2 (GPNF)	Uplands: Glyphosate Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate	Cut and paint stumps. Use foliar spray on smaller stems that can't be handpulled. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	-Use manual and manual treatments combined with herbicides. Smaller plants can be hand pulled or dug. - Manual Disposal: All portions of the plant should be removed. - For large plants, cutting and painting with herbicide is most effective. - Revegetate with desirable species in accordance with the Restoration Plan.
Bull thistle (*Cirsium vulgare*) **Spiny plumeless thistle (*Carduus acanthoides*)** **Biennial**	233 (GPNF)	Upland: A - Clopyralid, B - Picloram Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate	Spot spray whenever possible. Apply to rosettes in either the spring or fall. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.	- Use manual, mechanical or chemical control or a combination. - Any manual method that severs the root below the soil surface would kill these plants. Effective control requires cutting at the onset of blooming. Treatment before plants are fully bolted results in re-growth. Repeated visits at weekly intervals over the 4 to 7 week blooming period provide most effective control. -Manual Disposal: Bag and remove from site if plant has a flower head. - Timing of mowing is critical (within 2 days of full flowering for musk thistle). - Biological controls may be helpful to suppress populations in combination with other methods. - Revegetate with desirable species in accordance with the Restoration Plan.
Lesser burdock (*Arctium minus*) **Biennial**	17 (GPNF)	Upland: A- Metsulfuron methyl B – Triclopyr + Clopyralid Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate (not found as effective in the literature)	Spot spray whenever possible. Treat as a biennial. Treat in spring after rosettes are formed when non-targets are dormant or treat fall rosettes. * Very little was found on this species.*	- Use a combination of manual and herbicide. - Hand pull or dig small populations or when volunteer labor is available. - If chemicals are used, manual treatments could be used for follow-up. Relative amounts of herbicide to manual treatments would decline over time. - Revegetate with desirable species in accordance with the Restoration Plan.

Target Species – Common and *Scientific Names* and Growth Habit	Estimated Treatment Acres from 2004 Data Base	Documented Effective Herbicides	When/How to treat with Herbicides	Integrated Control Measures
Yellow nutsedge ***(Cyperus esculentus)*** **Perennial**	9 (GPNF)	Aquatic labeled Glyphosate	Spot spray whenever possible. Apply during active growth in midseason but before tubers begin to form. Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. Most information from the turf grass industry.	- Hand digging is effective if done before root tubers form. -Manual Disposal: All parts of the root system should be removed. - Out-competing through revegetation is the most effective means.
Everlasting Peavine ***(Lathyrus latifolius)*** **Birdfoot Deervetch** **(*Lotus corniculatus)*** **Aaron's Rod** **(*Thermopsis villosa*)** **Perennial**	6 (GPNF)	Upland: A-Clopyralid or Picloram (sites without grass cover) , B-Triclopyr or Imazapyr (sites without grass cover) Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate	Roadsides: Broadcast spray in dense cover or where dominant plant community is non-native. Otherwise, spot spray on patchy, diffuse roadside infestations. Follow PDC: they may require a less impacting treatment choice. Apply in the spring or early summer before bud stage or in the fall before the leaves start drying. Yearly revisits would be necessary;, the number of which is dependent on the chemical used and the seedbank.	-Herbicide treatment most effective. -Hand control possible with repeated effort or combined herbicide/hand treatment. - Hand removal must be repeated for several years. -Manual Disposal: Entire root system must be removed. - Revegetate with desirable species Revegetate with desirable species in accordance with the Restoration Plan.
Approximate total acreage to be treated (GPNF) = 2,350 Approximate total acreage to be treated (CRGNSA) = 360 Acres are estimated from field inventories documented in the 2004 Data Base. Acreages have been adjusted to account for spread since 2004, anecdotal information, and extrapolation into uninventoried areas. Columbia Gorge acres by targets species may overlap and therefore add up to more than 360 total acres.				

Treatment Methods

The Proposed Action employs a variety of invasive plant treatment methods (manual, mechanical, and herbicide treatments, and restoration methods). The following is a brief description of the different methods, based on Tu et al. 2001.

Cultural Treatment – Grazing with Goats

Grazing animals are limited to goats. Goat grazing alone would not eradicate invasive plants. However, when grazing treatments are combined with other control techniques, such as herbicides, large infestations would be reduced in size and small infestations could be eliminated. Grazing animals may be particularly useful in areas where herbicides cannot be applied (e.g., near water) or are prohibitively expensive (e.g., large infestations). Goats would be used as part of a restoration program by breaking up the soil and incorporating seeds of desirable plants. Grazing is proposed for managing weeds only at the St. Cloud/Sam Walker site in the CRGNSA.

Manual and Mechanical Treatment

Manual techniques in the proposed action include hand pulling, clipping, or digging out invasive plants with non-motorized hand tools. Mechanical methods involve chain saws, mowers, or other mechanized equipment, such as brush cutters, or other machinery with various types of blades to remove plants. Manual methods include the use of hand-operated tools (e.g., axes, brush hooks, hoes, shovels, hand clippers) to dig up and remove noxious species (USDA 2005a). Table 1 identified an array of treatment methods associated with target species. Appendix A in the DEIS identified manual and mechanical methods currently proposed for each identified treatment area based on the November 2004 Data Base.

These techniques tend to minimize damage to desirable plants and animals, but they are generally labor and time intensive. Treatments must typically be administered several times a year over several years to prevent the weed from re-establishing. Manual and mechanical techniques are generally favored to treat small infestations and/or in situations where a large pool of volunteer labor is available. They are often used in combination with other techniques. These techniques include weed pulling, clipping, clip and pulling, mowing, cutting and related activities, and stabbing, and girdling.

Weed pulling can be effective against some shrubs, tree saplings, and herbaceous weeds. Annuals and tap-rooted plants are particularly susceptible to control by hand-pulling. Weed wrenches and other tools can enable a person to control large saplings and shrubs that are too big to be pulled by hand. Weed pulling is not as effective against many perennial weeds with deep underground stems and roots that are often left behind to re-sprout.

Clipping removes seed heads and/or fruiting bodies to prevent germination. This method is labor intensive but effective for small and spotty infestations.

Clip and pulling is cutting a portion of the invasive plant stem and pulling it from its substrate, generally the bole of a tree. This method is labor intensive, but can be effective for larger infestations.

Mowing, cutting, brush hogging, raking, trimming, and weed eating can reduce seed production and restrict weed growth, especially in annuals cut before they flower and set seed. Some species however, vigorously sprout again when cut, replacing one or a few stems with many that can quickly flower and set seed. These treatments are used as primary treatments to remove aboveground biomass in combination with herbicide treatments to prevent re-sprouting, or as follow up treatments to treat target plants missed by initial herbicide use.

Stabbing the carbohydrate storage structure at the base of the plant can kill some plants. Depending on the species, this structure may be a root corm, storage rhizome (tuber), or taproot. These organs are generally located at the base of the stem and under the soil. Cutting off access to these storage structures can help "starve" or greatly weaken some species.

Girdling is often used to control trees or shrubs that have a single trunk. It involves cutting away a strip of bark several centimeters wide all the way around the trunk. The removed strip must be cut deep enough into the trunk to remove the vascular cambium, or inner bark, the thin layer of living tissue that moves sugars and other carbohydrates between areas of production (leaves), storage (roots), and growing points. This inner cambium layer also produces all new wood and bark.

Herbicide Treatment

The proposed action includes the use of ten herbicides applied up to the highest application rates noted in Table 2. The highest application rates would only be allowed when hand/select application methods are used. In no case would actual applications exceed rates listed on herbicide labels. Herbicide applications would primarily occur on terrestrial invasive plants growing along banks of streams, in roadside ditches and upland. In addition, treatment of invasive plants growing above the water's surface in ditches, small lakes, ponds, streams, stream margins, and/or wet areas (emergent target vegetation) is proposed. The 2004 Data Base of known plants for the GPNF and CRGNSA contain 5 sites with invasive plants that may require treatments below bankfull as well as above bankfull. Those sites are Cave Creek Meadows (Number 33-05m1), St. Cloud/Sam Walker (Number 22-03), Hot Springs (Number 22-04), Collin's Slide (Number 22-06), and Miller Island (Number 22-13) (Appendix B1 and B2). The EDRR program specifically limits treatments to no more than seven acres per sixth field watershed, per year (PDC H14, Table 5), for the sixth field watershed comprising the GPNF and CRGNSA.

Table 2. Herbicide Application Rates

Herbicide	Typical Application Rate lb ai/ac*	Highest Application Rate lb ai/ac
Chlorsulfuron	0.056	0.25
Clopyralid	0.35	0.5
Glyphosate	2	7
Imazapic	0.13	0.19
Imazapyr	0.45	1.25
Metsulfuron Methyl	0.03	0.15
Picloram	0.35	1.0
Sethoxydim	0.3	0.38
Sulfometuron Methyl	0.045	0.38
Triclopyr	1.0	10
Nonyl Phenol Ethoxylate (NPE)	1.67	6.68
Hexachlorobenzene#	0.000004	0.000012

* pounds of active ingredient per acre
#These application rates reflect the incidental rates of application of the impurity hexachlorobenzene, found primarily in picloram, and to a lesser extent in clopyralid.

The R6 2005 FEIS/ROD allows treatment of all invasive plants, with the exception of those that are submerged and/or floating. Therefore, treatment of "emergent" invasive plants is permitted according to the standards in the R6 2005 FEIS/ROD. This consultation covers three types of herbicide application methods: broadcast spray, spot spray, and hand/selective.

Broadcast methods distribute herbicide over broad areas covering both target plants and non-target plants. Broadcast treatments would typically be used to treat denser patches of target vegetation (where target vegetation covers approximately 70 percent of the area or more). Broadcast methods include booms; boom-less nozzles, and backpack sprayers if not directed at individual plants. A boom, a long horizontal tube with multiple spray heads, may be mounted or attached to a tractor, ATV or other vehicle. The boom is then carried above the weeds while spraying herbicide, allowing large areas to be treated rapidly with each sweep of the boom.

Spot spray application directs spray onto small patches or individual target plants; non-target plants are intended to be avoided. Applicators range from motorized rigs with spray hoses to backpack sprayers, to hand-pumped spray or squirt bottles, all of which can target very small plants or parts of plants. Applications are typically hand-directed. The spray is directed immediately toward the target plant.

Hand/selective methods treat individual target plants. They intend to reduce the potential for herbicide to contact soil or non-target organisms. Hand/selective methods include wicking and wiping; basal bark treatment; frill, hack and squirt; stem injection; and/or cut-stump methods.

Wicking, wiping, and other stem and/or leaf application -involves using a sponge, spray bottle, paint brush, cloth and/or a wick on a long handle to wipe or apply herbicide onto individual foliage and/or stems. Use of a wick or wiping mentioned above intends to eliminate or minimize the possibility of spray drift and the potential for droplets falling on non-target plants.

Basal bark method applies a six to 12 inch band of herbicide around the circumference of the trunk of the target plant, approximately one foot above ground. The width of the sprayed band depends on the size of the plant and the species' susceptibility to the herbicide.

The frill, hack, and squirt methods are often used to treat woody species with large, thick trunks. The tree is cut using a sharp knife, saw, or ax, or drilled with a power drill or other device. Herbicide is then immediately applied to the cut with a backpack sprayer, squirt bottle, syringe, or similar equipment. Because the herbicide is placed directly onto the thin layer of growing tissue in the trunk (the cambium), an ester formulation is not required.

Herbicides can be injected into herbaceous stems using a needle and syringe, otherwise known as stem injection. Herbicide pellets can also be injected into the trunk of a tree using a specialized tool. Higher concentrations of active ingredients are often needed for effective stem injection, e.g. maximum label rate of aquatic labeled glyphosate to effectively kill knotweed by stem injection).

The cut-stump method is often used on woody species that normally re-sprout after being cut. The tree or shrub is cut down, and herbicide is immediately sprayed or squirted on the exposed cambium (living inner bark) of the stump. The herbicide must be applied to the entire inner bark (cambium) within minutes after the trunk is cut. The outer bark and heartwood do not need to be treated since these tissues are not alive, although they support and protect the tree's living tissues. The cut stump treatment allows for a great deal of control over the site of herbicide application and requires only a small amount of herbicide to be effective.

Surfactants and Additives. Herbicide manufacturers add inert ingredients (or other ingredients) to enhance the action of the active ingredient. Inert ingredients may include carriers, surfactants, spray adjuvants, preservatives, dyes, and anti-foaming agents among other chemicals. Because many manufacturers consider inerts in their herbicide formulations to be proprietary, they do not list specific chemicals. Several types of surfactants or additives are proposed for use and have been reviewed in risk assessments or reviews and thus meet the standards contained in the GPNF and CRGNSA Land and Resource Management Plans (LRMP), as amended by the R6 2005 ROD. These additives are used to help herbicides adhere to target plants and reduce drift (Bakke 2003). For the proposed action, only those additives that are approved by the Washington State Department of Agriculture (WSDA) and Department of Ecology (Ecology) and comply with the amended GPNF and CRGNSA LRMPs will be permitted for use within riparian areas (Table 3).

Adjuvants are solution additives that are mixed with herbicide solutions to improve performance of the spray mixture. They can either enhance activity of the herbicide's active ingredient or offset any problems associated with spray application. Adjuvants include surfactants, anti-foaming agents, crop oil or crop oil concentrates, drift retardants, compatibility agents, and pH buffers. Surfactants reduce the surface tension of water and form a bridge between two chemicals that do not readily mix.

Carriers are used to dilute or suspend herbicides during application and allow for proper placement of the herbicide, whether to soil or on foliage.

Table 3. Products approved by WSDOA, Ecology and that meet GPNF and CRGNA LRMP standards.

Product Name	Registrant	Principal Functioning Agent	Document supporting Std 18*
Agri-Dex	Helena Chemical Company	Petroleum Oil, polyoxyethylene sorbitant fatty acid ester, sorbitant fatty acid ester	Syracuse Environmental Research Associates (SERA) 1997, Bakke 2003
Competitor	Wilbur-Ellis Company	Modified vegetable (seed) oil, polyethylene glycol fatty acid ester, polyoxyethylene sorbitant fatty acid ester	SERA 1997, Bakke 2003
InterLock	Agriliance	Modified vegetable (seed) oil, polyoxyethylene sorbitant fatty acid ester, vegetable (seed) oil	SERA 1997, Bakke 2003
LI 700	Loveland Industries/Loveland Products	Phosphatidylcholine, propanoic (propionic) acid, alkylphenol ethoxylate	SERA 1997, Bakke 2003
Liberate	Loveland Industries/Loveland Products	Phosphatidylcholine, alcohol ethoxylate, modified vegetable (seed) oil	SERA 1997, Bakke 2003
Dyne-Amic	Helena Chemical Company	Modified vegetable (seed) oil, alkylphenol ethoxylate, Polysiloxane polyether copolymer	Bakke 2003
Cygnet Plus	Brewer International	Modified vegetable (seed) oil, alcohol ethoxylate, Limonene	USDA Forest Service 1992

* Standard 18 is one of the prevention standards proposed in the R6 2005 FEIS and states that the FS will only use adjuvants and inert ingredients reviewed in the FS hazard and risk assessment documents.

Project Design Features

The GPNF and CRGNSA propose the following PDCs and buffers as measures to minimize or eliminate the potential undesirable environmental results of invasive plant treatment (as per R6 2005 ROD Standards 19 and 20 and other Forest Plan management direction), and provide sideboards for treatment of EDRR program sites. Implementation of the PDCs and buffers are mandatory to ensure that treatments would have effects within the scope of those addressed below. The PDCs were developed to address a range of site-specific resource conditions within treatment areas, including (but not limited to): the presence of listed species and designated critical habitat, the potential for herbicide delivery to water, and the social environment.

The PDCs add layers of caution to herbicide label requirements and R6 2005 FEIS standards by limiting the rate and method of herbicide application, by buffering streams from varying herbicide application methods, and by restricting certain higher-risk herbicides near streams. The GPNF and CRGNSA assert that this conservative approach was taken to limit the potential for herbicides coming in contact with water at concentrations of concern, while allowing for a range of effective treatments for known and predicted situations. Under the proposed action, buffers along streams, lakes, ponds, and wetlands in Tables 5, 6, and 7 would be required.

The following list includes the PDCs specific to avoiding or minimizing potential effects of the proposed action on ESA-listed species and their habitat, which are included as part of the proposed action.

Table 4. Project Design Features for the ONF invasive plant treatment program

PDC Reference	Design Criteria	Purpose of PDC	Source of PDC
A	**Pre-Project Planning**		
A1	Prior to treatment, confirm species/habitats of local interest, watershed and aquatic resources of concern (e.g. hydric soils, streams, lakes, roadside treatment areas with higher potential to deliver herbicide, municipal watersheds, domestic water sources), and places where people gather, and range allotment conditions.	Ensure project is implemented appropriately.	This approach follows several previous NEPA documents. Pre-project planning also discussed in the previous section.
B	**Coordination with Other Landowners/Agencies**		
B1	Work with owners and managers of neighboring lands to respond to invasive plants that straddle multiple ownerships. Coordinate treatments within 150 feet of Forest boundaries, including lands over which the Forest has right-of-way easements, with adjacent landowners.	To ensure that neighbors are fully informed about nearby herbicide use and to increase the effectiveness of treatments on multiple ownership lands.	The distance of 150 feet was selected because it approximates the Aquatic Influence Zone for fish bearing streams.
B2	Coordinate herbicide use within 1000 feet (slope distance) of known water intakes with the water user or manager.	To ensure that neighbors are fully informed about nearby herbicide use.	The distance of 1000 feet was selected to respond to public concern. Herbicide use as proposed for this project would not contaminate drinking water supplies.

PDC Reference	Design Criteria	Purpose of PDC	Source of PDC
B3	Coordinate herbicide use with Municipal Water boards. Herbicide use or application method may be excluded or limited in some areas.	To ensure that neighbors are fully informed about nearby herbicide use and standards for municipal watersheds are met.	1990 Gifford Pinchot National Forest Plan and existing municipal agreements.
C	**To Prevent the Spread of Invasive Plants During Treatment Activities**		
C1	Ensure vehicles and equipment (including personal protective clothing) do not transport invasive plant materials.	To prevent the spread of invasive plants during treatment activities	Common measure.
D	**Wilderness Areas**		
D1	No cultural, mechanical or motorized treatments would occur in Wilderness areas.	To maintain Wilderness character and meet environmental standards.	Wilderness Act, 1990 Gifford Pinchot National Forest Plan
D2	Choose minimum impact treatment methods.	To maintain Wilderness values (e.g. solitude, unimpeded natural processes) and comply with environmental laws and policies.	Wilderness Act, 1990 Gifford Pinchot National Forest Plan
E	**There are no Design Features under "E".**		
F	**Herbicide Applications**		
F1	Herbicides would be used in accordance with label instructions and advisories, except where more restrictive measures are required as described herein. Herbicide applications would only treat the minimum area necessary to meet site objectives. Herbicide formulations would be limited to those containing one or more of the following 10 active ingredients: chlorsulfuron, clopyralid, glyphosate, imazapic, imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, and triclopyr. Herbicide application methods include wicking, wiping, injection, spot, and broadcast, as permitted by the product label and these Project Design Features. The use of triclopyr is limited to spot and hand/selective methods. Herbicide carriers (solvents) are limited to water and/or specifically labeled vegetable oil	To limit potential adverse effects on people and the environment.	Standard 16, R6 2005 ROD; Pesticide Use Handbook 2109.14
F2	Herbicide use would comply with standards in the Pacific Northwest Regional Invasive Plant Program – Preventing and Managing Invasive Plants FEIS (2005), including standards on herbicide selection, restrictions on broadcast use of some herbicides, tank mixing, licensed applicators, and use of adjuvants, surfactants and other additives. See Appendix B for tank mixture analysis.	To limit potential adverse effects on people and the environment.	R6 2005 ROD Treatment Standards
F3	The POEA surfactants, urea ammonium nitrate or ammonium sulfate would not be used in applications within 150 feet of surface water, wetlands or on roadside treatment areas having high potential to deliver herbicide.	To protect aquatic organisms.	The distance of 150 feet was selected because it is wider than the largest buffer and approximates the Aquatic Influence Zone for fish bearing streams.

PDC Reference	Design Criteria	Purpose of PDC	Source of PDC
F4	The lowest effective application rates would be used for each given situation. In no case would broadcast applications of herbicide or surfactant exceed typical label rates. The NPE surfactant would not be broadcast at a rate exceeding 0.5 pounds (lbs.) active ingredient per acre (a.i./ac.), Other classes of surfactants besides NPE would be favored wherever they are expected to be effective. In no case would imazapyr be applied at a rate exceeding 0.70 lbs. a.i./ac.	To eliminate possible herbicide or surfactant exposures of concern to human health, and/or wildlife.	SERA Risks Assessments, Appendix Q of the R6 2005
F5	Herbicide applications would occur when wind velocity is between two and eight miles per hour. During application, weather conditions would be monitored periodically by trained personnel.	To ensure proper application of herbicide and reduce drift.	These restrictions are typical so that herbicide use is avoided during inversions or windy conditions.
F6	To minimize herbicide application drift during broadcast operations, use low nozzle pressure; apply as a coarse spray, and use nozzles designed for herbicide application that do not produce a fine droplet spray, e.g., nozzle diameter to produce a median droplet diameter of 500-800 microns.	To ensure proper application of herbicide and reduce drift.	These are typical measures to reduce drift. The minimum droplet size of 500 microns was selected because this size is modeled to eliminate adverse effects on non-target vegetation 100 feet or further from broadcast sites (see Chapter 3.2 of the 2006 GPNF/CRGNSA DEIS for details).
G	**Herbicide Transportation and Handling Safety/Spill Prevention and Containment**		

PDC Reference	Design Criteria	Purpose of PDC	Source of PDC
G	An Herbicide Transportation and Handling Safety/Spill Response Plan would be the responsibility of the herbicide applicator. At a minimum the plan would: • Address spill prevention and containment. • Estimate and limit the daily quantity of herbicides to be transported to treatment sites. • Require that impervious material be placed beneath mixing areas in such a manner as to contain small spills associated with mixing/refilling. • Require a spill cleanup kit be readily available for herbicide transportation, storage and application (minimum FOSS Spill Tote Universal or equivalent). • Outline reporting procedures, including reporting spills to the appropriate regulatory agency. • Ensure applicators are trained in safe handling and transportation procedures and spill cleanup. • Require that equipment used in herbicide storage, transportation and handling are maintained in a leak proof condition. • Address transportation routes so that traffic, domestic water sources, and blind curves are avoided to the extent possible. • Specify conditions under which guide vehicles would be required. • Specify mixing and loading locations away from water bodies so that accidental spills do not contaminate surface waters. • Require that spray tanks be mixed or washed further than 150 feet of surface water. • Ensure safe disposal of herbicide containers. Identify sites that may only be reached by water travel and limit the amount of herbicide that may be transported by watercraft.	To reduce likelihood of spills and contain any spills.	Pesticide Use Handbook FSH 2109.14, Bonneville Power Administration Biological Assessment, Buckhead Knotweed Project, Willamette NF Biological Assessment
H	**Soils, Water and Aquatic Ecosystems**		
H1	Herbicide use buffers have been established for perennial and wet intermittent steams; dry streams; and lakes and wetlands. These buffers are depicted in the tables below. Buffers vary by herbicide ingredient and application method. Tank mixtures would apply the largest buffer as indicated for any of the herbicides in the mixture.	To reduce likelihood that herbicides would enter surface waters in concentrations of concern. Comply with R6 2005 ROD Standards 19 and 20.	Buffers are based on label advisories, and SERA risk assessments. Buffer distances are based on the Berg's 2004 study of broadcast drift and run off to streams, along with Washington State Dept. of Agriculture's 2003-2005 monitoring results.

PDC Reference	Design Criteria	Purpose of PDC	Source of PDC
H2	The following treatment methods are shown in order of preference (if effective and practical), within roadside treatment areas having high risk of herbicide delivery to streams and, in wetlands, near aquatic influence areas, especially adjacent to fish bearing streams: (1) Manual methods (e.g, hand pulling). (2) Application of clopyralid, imazapic, and metsulfuron methyl, aquatic glyphosate, aquatic triclopyr, aquatic imazapyr. (3) Application of chlorsulfuron, imazapyr, sulfometuron methyl. (4) Application of glyphosate, triclopyr, picloram, and sethoxydim (see H3, picloram or non-aquatic triclopyr would not be used on roadside treatment areas that have a high risk of herbicide delivery).	To protect aquatic organisms by favoring lower risk methods where effective.	Herbicides were classed into low, moderate and higher risk to aquatic organisms based on SERA Risk Assessments. Lower risk herbicides are preferred where effective. Non-herbicide, manual methods have the least potential for impact, therefore they would be preferred.
H3	No use of picloram or Triclopyr BEE, and no broadcast of any herbicide on ***the entire*** roadside treatment areas that have a high risk of herbicide delivery to surface waters (see Appendix D of the 2006 GPNF and CRGNSA DEIS for map and list of these roads).	To ensure herbicide is not delivered to streams in concentrations that exceed levels of concern.	SERA Risk Assessments, R6 2005 FEIS and BA
H4	Aquatic labeled herbicides or herbicides associated with lower risk to aquatic organisms would be applied using spot or hand/selective methods within 15 feet of the edge of a wet roadside ditch. For treatments of target vegetation emerging out of the wet roadside ditch only aquatic labeled herbicides would be used.	To ensure herbicide is not delivered to streams in concentrations that exceed levels of concern.	SERA Risk Assessments R6 2005 FEIS and BA Extra caution is warranted on the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area (Washington side) because of the many listed species in Forest streams.
H5	Vehicles (including all terrain vehicles) used to access or implement invasive plant projects would remain on roadways, trails, parking areas or other previously disturbed areas to prevent damage to riparian vegetation and soil, and potential degradation of water quality and aquatic habitat.	To protect riparian and aquatic habitats.	SERA Risk Assessments R6 2005 FEIS and BA
H6	Avoid use of clopyralid on high-porosity soils (coarser than a loamy sand).	To avoid leaching/ground water contamination.	Label advisory.
H7	Avoid use of chlorsulfuron on soils with high clay content (finer than loam).	To avoid excessive herbicide runoff.	Label advisory.

PDC Reference	Design Criteria	Purpose of PDC	Source of PDC
H8	Avoid use of picloram on shallow or coarse soils (coarser than loam.) No more than one application of picloram would be made within a two-year period, except to treat areas missed during initial application.	To reduce the potential for picloram to enter surface and/or ground water and/or accumulate in the soil. Picloram has the highest potential to impact organisms in soil and water, and tends to be more persistent than the other herbicides.	SERA Risk Assessment. Based on quantitative estimate of risk from worst-case scenario and uncertainty.
H9	Avoid use of sulfometuron methyl on shallow or coarse soils (coarser than loam.) No more than one application of sulfometuron methyl would be made within a one-year period, except to treat areas missed during initial application.	To reduce the potential for sulfometuron methyl accumulation in the soil. Sulfometuron methyl has some potential to impact soil and water organisms and is second most persistent.	SERA Risk Assessments. Based on quantitative estimate of risk from worst-case scenario and uncertainty.
H10	Lakes and Ponds — No more than half the perimeter or 50 percent of the vegetative cover or 10 contiguous acres around a lake or pond would be treated with herbicides in any 30-day period.	To reduce exposure to herbicides by providing some untreated areas for some organisms to use.	SERA Risk Assessments. Reduces exposure to herbicides by providing untreated areas for organisms to use. Abates risks associated with worst-case scenarios and uncertainty regarding effects on reptiles and amphibians.
H11	Wetland vegetation would be treated when soils are driest. If herbicide treatment is necessary for emergent target plants when soils are wet, use aquatic labeled herbicides. Favor hand/selective treatment methods where effective and practical.	To reduce exposure to herbicides by providing some untreated areas for some organisms to use.	SERA Risk Assessments. Reduces exposure to herbicides by providing untreated areas for organisms to use. Abates risks associated with worst-case models for treatment of emergent vegetation.
H12	Broadcast spraying would not occur within 50 feet of well. Follow label guidance relative to water contamination.	Safe drinking water.	Label advisories and state drinking water regulations.
H13	With the exception of hand/select methods, herbicides would be applied at typical (or lower) rates within Aquatic Influence Zones.	To ensure herbicide exposures are below thresholds of concern for aquatic ecosystems.	SERA Risk Assessments, Biological Assessment
H14	Treatments above bankfull, within the aquatic influence zone, would not exceed 10 acres along any 1.5 mile of stream reach within a sixth field subwatershed in any given year. In addition, treatments below bankfull would not exceed 7 acres total within a sixth field sub-watershed in any given year.	Limits the extent of treatment within the Aquatic Influence Zone so that adverse effects are within the scope of analysis.	SERA Risk Assessment worksheets and emergent vegetation analysis.
H16	Plan and schedule project activities to avoid disturbance of spawning fish or damage to redds.	Minimize adverse impacts within waterbodies.	Memorandum of Understanding between WDFW and USDA Forest Service, January 2005
H17	Limit the numbers of people on any one site at any one time while treating areas within 150 feet of creeks.	To minimize trampling and protect riparian and aquatic habitats.	The distance of 150 feet was selected because it approximates the Aquatic Influence Zone for fish bearing streams.

PDC Reference	Design Criteria	Purpose of PDC	Source of PDC
H18	Fueling of gas-powered equipment with gas tanks larger than 5 gallons would not occur within 150 feet of surface waters. Fueling of gas-powered equipment with gas tanks smaller than 5 gallons would not occur within 25 feet of any surface waters.	To protect riparian and aquatic habitats.	The distance of 150 feet was selected because it approximates the Aquatic Influence Zone for fish bearing streams. Filling of smaller tanks has inherently less risk.

Buffers

The proposed buffers result from the worst-case scenarios analyzed in the SERA risk assessments, risk levels associated with aquatic organisms as identified in the R6 2005 BA (USDA 2005a), differences in application methods, whether water is present at the treatment site or not, buffers from previous Section 7 ESA consultations on herbicide treatments, Forest Service monitoring results from Neil Berg (2004), Washington State Department of Agriculture 2003-2005 monitoring results and inherent herbicide properties.

Buffer distances shown in Tables 5, 6, and 7 are measured in feet for perennial and wet intermittent streams, streams that are dry at the time of treatment, and wetlands, high water table areas, lakes and ponds. Buffers are measured as horizontal distance from bankfull or the ordinary high water mark.

Table 5. Perennial and wet intermittent stream buffers.

Herbicide	Perennial and Wet Intermittent Stream Buffers		
	Broadcast (feet)	**Spot (feet)**	**Hand/ Select (feet)**
Chlorsulfuron	100	50	Bankfull
Clopyralid	100	15	Bankfull
Glyphosate	100	50	50
Glyphosate (Aquatic Formula)	*50*	*No buffer***	*No buffer*
Imazapic	100	15	Bankfull
Imazapyr	100	50	Bankfull
Imazapyr (Aquatic Formula)	*50*	*No buffer*	*No buffer*
Metsulfuron Methyl	100	15	Bankfull
Picloram	100	50	50
Sethoxydim	100	50	50
Sulfometuron Methyl	100	50	Bankfull
Triclopyr-BEE	None Allowed	150	150
Triclopyr-TEA (Aquatic Formula)	None Allowed	15	*No buffer*

**No buffer means that treatment may occur anywhere across the stream channel where target vegetation exists including backwater channels, braided streams, floodplains, etc., even when water is present.

Table 6. Buffers for streams that are dry at the time of treatment.

Herbicide	Buffers For Streams That Are Dry At The Time Of Treatment		
	Broadcast (feet)	**Spot (feet)**	**Hand/ Select (feet)**
Chlorsulfuron	*50*	15	Bankfull
Clopyralid	*50*	Bankfull	*No buffer*
Glyphosate	100	50	50
Glyphosate (Aquatic Formulation)	*50*	*No buffer*	*No buffer*
Imazapic	*50*	Bankfull	*No buffer*
Imazapyr	*50*	15	Bankfull
Imazapyr (Aquatic Formulation)	*50*	*No buffer*	*No buffer*
Metsulfuron Methyl	*50*	Bankfull	*No buffer*
Picloram	100	50	50
Sethoxydim	100	50	50
Sulfometuron Methyl	*50*	15	Bankfull
Triclopyr-BEE	None Allowed	150	150
Triclopyr-TEA (Aquatic Formula)	None Allowed	15	*No buffer*

**No buffer means that treatment may occur anywhere across the stream channel where target vegetation exists including backwater channels, braided streams, floodplains, etc., even when water is present.

Table 7. Buffers for wetlands, high water table areas, lakes and ponds.

Herbicide	Wetlands, High Water Table Areas, Lakes and Ponds		
	Broadcast (feet)	**Spot (feet)**	**Hand/ Select (feet)**
Chlorsulfuron	100	50	Water's Edge
Clopyralid	100	15	Water's Edge
Glyphosate	100	50	50
Glyphosate (Aquatic Formula)	*50***	*No buffer*	*No buffer*
Imazapic	100	15	Water's Edge
Imazapyr (Aquatic Formula)	*50***	*No buffer*	*No buffer*
Imazapyr	100	50	Water's Edge
Metsulfuron Methyl	100	15	Water's Edge
Picloram	100	50	50
Sethoxydim	100	50	50
Sulfometuron Methyl	100	50	Water's Edge
Triclopyr-BEE	None Allowed	150	150
Triclopyr-TEA (Aquatic Formula)	None Allowed	15	*No buffer*

**If wetland, pond or lake is dry, there is no buffer. No buffer means that treatment may occur anywhere across the stream channel where target vegetation exists including backwater channels, braided streams, and floodplains.

Roadside Ditch Treatments

The majority of known treatment sites on the GPNF and CRGNSA are along roadways. As part of their road management strategy, the GPNF and CRGNSA have identified roadways that have the potential to deliver sediment to fish habitat. The identification is based on proximity (delivery) to fish habitat, stream crossing density, and stream proximity. For this consultation, the likelihood of delivering herbicide into fish bearing waters is considered analogous to the likelihood of delivering sediment via runoff. That is, roads defined as having a high potential for sediment delivery also are likely to deliver herbicide. PDCs H2, H3 and H4 apply to roadside treatments and provide additional restrictions to roads having a high potential for herbicide delivery with the intent to reduce the effects of herbicides entering fish bearing waters via runoff. Road segments identified as a high potential for herbicide delivery may extend beyond stream buffers. In addition, there are some roads in some of the watersheds that contain listed fish that cross or discharge directly into mapped LCS streams and are not listed as having a high potential for herbicide delivery (Harke pers. com. 2007).

The PDC H3 prohibits all broadcast spraying of any herbicide on "high risk of herbicide delivery" roadsides. The GPNF and CRGNSA will not allow broadcast spraying within the entire roadside treatment, including the ditch bottom and the upslope side of the ditch. In contrast, there are no PDCs prescribing spot or selective applications within or along roadside ditches. NMFS assumes that the buffers from Tables 5 and 6 will apply. For those tables to apply to roadside ditches, NMFS also assumes that the term "bankfull" includes the road shoulder. Thus, there are numerous herbicides, illustrated in Tables 5 and 6, which can be spot sprayed and selective applied along roadsides and directly within ditches.

In addition, PDC H4 restricts the use of certain herbicides within 15 feet of a wet area within a roadside ditch. The purpose of PDC H4 is to limit herbicide use to lower risk herbicides (clopyralid, imazapic, and metsulfuron methyl) to within 15 feet of roadside ditch standing water. When herbicides are likely to get into standing water, the GPNF and CRGNSA will follow label requirements and will therefore use the aquatic labeled herbicides (imazapyr, triclopyr and glyphosate) when applying to emergent vegetation within any wet ditch.

Restoration Methods

Restoring treated sites can include active mulching, seeding, and planting with desired target vegetation. Machine mulching will be limited to areas that are on roads. Deep-rooted shrubs may also be seeded or planted to more fully utilize resources from the lower soil profile, especially late in the growing season. Planting of native shrubs may also occur in cases where rapid revegetation is desired. Restoration can also be passively accomplished where desirable vegetation is able to naturally replace removed target invasive species. The tools and methods used for restoration activities are the same as those used for manual and mechanical treatments.

Restoration prescriptions will be developed by appropriate GPNF and CRGNSA staff during implementation planning and will be influenced by site-scale conditions and broader land management objectives (for more information on restoration prescription process, see Appendix F of the 2006 GPNF and CRGNSA DEIS, Excerpts from the 2003 Draft Guidelines for Revegetation of Weed Sites and Other Disturbed Areas on National Forests and Grasslands in the Pacific Northwest).

The GPNF and CRGNSA assumes that passive restoration will be successful on about 35 percent of the treatment sites, with 65 percent needing some kind of mulching, seeding, and/or infrequent planting. This proportion is based on the range of situations surrounding the inventoried invasive plant populations known across the forest and scenic area. For instance, meadows and forested areas are most likely to respond favorably to passive restoration, while roadsides and other highly disturbed areas may require mulching and/or seeding/planting with desirable vegetation. The intent is to re-establish competitive local, native vegetation post-treatment in areas of bare ground. In some cases, preferred non-natives may be utilized as temporary ground cover for erosion control and as noxious weed competitors, until native species can become established at the site. Preferred non-native plants would not aggressively compete with natives, persist long-term, or exchange genetic material with local native plant species.

Evaluation for site restoration may occur before, during and after herbicide, manual and mechanical treatments. Passive site restoration would be favored in areas having a stable, diverse, native plant community and sufficient organics in the soil to sustain natural revegetation. If the soils lack sufficient organics, mulch and/or fungal mycorrhizae would be added.

Implementation Planning Process

To ensure the consistency of approach and compliance with this proposed action, treatment of all known or future invasive plant treatment sites will follow the methods outlined below. The methodology follows Integrated Weed Management (IWM) principles (R6 2005 FEIS) (USDA 2005a) and satisfies FS pesticide use planning requirements. It applies to currently known infestations and new sites found within or outside currently mapped treatment areas during ongoing inventory. Appropriate FS specialists will review and designated appropriate PDCs for the final site-specific prescription. For example, GPNF and CRGNSA fish biologists will review the annual program of work to ensure that appropriate buffer widths are included where listed species are present.

I. Characterize invasive plant infestations to be treated.

- Map and describe target species, density, extent, treatment strategy and priority.
- Add or refine target species information to database.
- Validate affected environment at the treatment site and ensure no extraordinary site conditions exist that were not considered in 2008 GPNF and CRGNSA Final Environmental Impact Statement. New treatment areas found during future inventories will be evaluated for extraordinary site conditions which may trigger additional NEPA or ESA requirements. For example, new information may reveal that an action may affect listed species in a way not previously considered; or methods needed to be effective would not be consistent with the PDCs and/or buffer requirements. Specific site conditions, such as soil type and depth to groundwater, will be considered in developing site-specific prescriptions.

II. Develop site-specific prescriptions.

- Use IWM principles (R6 2005 FEIS) (USDA 2005a) to identify possible effective treatment methods. Considerations include the biology of the target species and surrounding environment (these items are also evaluated when invasive plant infestations are characterized). Determine whether effective methods are within the scope of those analyzed in the 2008 GPNF and CRGNSA Final Environmental Impact Statement. Prescribe herbicides as needed based on the biology of the target species and size of the infestations. If effective methods have ecosystem effects that are outside the scope of those analyzed in the 2008 GPNF and CRGNSA Final Environmental Impact Statement, additional NEPA and ESA analyses would be required.
- Broadcast application of herbicide would be considered for situations warranted by the density (approximately 70 to 80 percent cover) or the distribution (e.g. continuous target populations along a road), or both, of invasive plants, unless limited by PDCs (see Table 4). Broadcast applications would not occur on any road systems identified as having high potential to deliver herbicide to streams (Appendix F of the BA). Under the Proposed Action, broadcast applications

along stream channels, lakes, and wetlands would be restricted by PDCs and required buffers (Tables 5, 6, and 7).

- Apply appropriate standards from the GPNF LRMP as amended, and specific PDCs and buffers based on:
  - The size of the infestation, its treatment history and response to past treatment,
  - Proximity to listed species and/or their habitats
  - Proximity to streams, lakes, wetlands
  - Whether the treatment site is along a road associated with high risk of herbicide delivery to surface water
  - Soil conditions
  - Municipal watersheds and/or domestic water intakes
  - Places people gather (recreation areas, special forest product and special use areas).
  - Effective herbicide (or mixture) and method of application needed.
  - Additional considerations, such as weather conditions, can be found in the PDC section. Specialists will review and apply appropriate PDCs for the final site-specific prescription. For example, a fish biologist will review the annual program of work to ensure that appropriate buffer widths are included where federally-listed fish are present
- Review compliance criteria for Forest Plan and other environmental standards that apply to a given treatment site.
- If treatments would not be effective once PDCs are applied, further NEPA or ESA analysis may be required to authorize an alternative treatment.
- Review manual for Scotch broom treatments to ensure no effect on heritage resources.
- Complete Form FS-2100-2 (reproduced in Appendix E of the 2006 GPNF and CRGNSA DEIS), Pesticide Use Proposal. This form lists treatment objectives, specific herbicide(s) that would be used, the rate and method of application, and PDCs that apply. No permit is required from WSDA for treatment of terrestrial invasive plants.
- Confirm that surfactants proposed meet requirement of the GPNF LRMP.
- Confirm restoration plan and ensure acceptable plant or mulch materials are available.
- Determine need for pre-project surveys for listed species and/or their habitats.
- Coordinate with adjacent landowners, water users, agencies, and partners.
- Document the public notification plan.

III. Accomplishment and Compliance Monitoring.

- Develop a project work plan for herbicide use as per the FS Pesticide Use Handbook (FSH 2109.14.3). This work plan presents organizational and operational details including the precise treatment objectives, the equipment, materials, and necessary supplies, the herbicide application method and rate; field crew organization and lines of responsibility and a description of interagency coordination.
- Ensure contracts and agreements include appropriate prescriptions and that herbicide ingredients and application rates meet label requirements, R6 2005 ROD (USDA 2005b), and site-specific PDCs. Contracts and agreements will include the appropriate PDCs, buffers, and approved surfactants.
- Document and report herbicide use and certified applicator information in the National pesticide use database, via the Forest Service Activity Tracking System (FACTS). A pesticide use report extracts data from FACTS. See Appendix E of the 2006 GPNF and CRGNSA DEIS for reporting forms.
- The WSDA is the responsible agency for pesticide management. The WSDA also holds the National Pollutant Discharge Elimination System permit (NPDES) for use of herbicides to control aquatic and/or emergent noxious weeds in Washington State
- Implement the public notification plan and document accomplishments.
- For future or unknown infestations (EDRR program treatments), a Project Consistency Evaluation Form (PCEF) will be completed for each treatment each treatment in the action area. The GPNF and CRGNSA currently use a PCEF to evaluate the effects of proposed actions on listed species. In addition, the GPNF and CRGNSA propose to annually develop a Geographical Information Survey (GIS) database of all herbicide treatments. Each treatment will have information associated with it, such as what weeds are occurring, what treatment method, chemical, application rate and method will be employed.
- Non-herbicide treatments should be included and reported in the FACTS database.

IV. Post-treatment Monitoring, Recurring Treatments, and Adaptive Management.

- Implementation monitoring would occur during implementation to ensure PDCs are implemented as planned. Post-treatment reviews would occur on a sample basis to determine whether treatments were effective and whether or not restoration has occurred as expected. Non-target vegetation (e.g., botanical species of local interest) would be evaluated before and immediately after treatment, and two to three months later.
- Contract administration and other existing mechanisms would be used to correct deficiencies. Herbicide use would be reported as required by the FSH 2109.14 and FACTS (see Appendix E of the 2006 GPNF and CRGNSA DEIS).

- Post-treatment monitoring would also be used to detect whether PDCs were appropriately applied, and whether non-target vegetation impacts are within tolerable levels.
  - Re-treatment and active restoration prescriptions would be developed based on post-treatment results. Changes in herbicide or non-herbicide methods, within the scope of the 2006 GPNF and CRGNSA DEIS and this Opinion, would occur based on results. For instance, an invasive plant population treated with a broadcast herbicide may be retreated with a spot spray, or later manually pulled, once the size of the infestation is sufficiently reduced following the initial treatment.
  - Treatment buffers would be expanded if damage were found outside buffers as indicated by a decrease in the size of any non-target plant population, leaf discoloration or chlorophyll change, or mortality to individual species of local interest or non-target vegetation. The findings would be applied to buffers for waterbodies. Buffers may be adjusted for certain herbicides and application methods and not others, depending on results.
- Additional monitoring may be included as part of the GPNF and CRGNSA Annual Monitoring Plans or other ongoing programs such as state water quality monitoring. The R6 2005 ROD adopted a monitoring framework to ensure listed species are protected. Treatments within riparian areas may be selected for monitoring as part of this regional, interagency effort. If the Regional Monitoring Framework is not developed or near completion by 2007, then the GPNF and CRGNSA will develop their monitoring framework for high risk sites by December 2008.
- Reporting forms and summaries will be submitted to NMFS and USFWS annually, at the beginning of each calendar year, and a meeting to assess adherence will be conducted following receipt.

Monitoring

The GPNF and CRGNSA invasive plants coordinators are maintaining an up-to-date invasive plant inventory using NRIS/Terra (an FS accepted protocol at the national level). The inventory will be used as the main vehicle for tracking treatment effectiveness at site-specific, Forest-wide, and Regional scales.

The GPNF and CRGNSA Plan includes a Monitoring Plan to assess treatment effectiveness. Annually, monitoring results are reported by Forest staff. In addition, the R6 2005 ROD established a framework for project and program monitoring (see Appendix M of the R6 2005 ROD) (USDA 2005b).

Results from implementation/compliance and effectiveness monitoring (both the effectiveness of treatments in meeting project objectives, and effectiveness of protection measures) will be used to identify and respond to changing conditions and new information and assess the need to make changes to treatment and restoration prescriptions within the scope of this consultation. If there is a need to make changes to treatment and restoration strategies outside the scope of this analysis, then the GPNF and

CRGNSA will need to do additional NEPA and ESA analysis, and potentially reinitiate consultation.

Implementation and Compliance Monitoring

Implementation/compliance monitoring answers the question, "Did we do what we said we would do?" This question will be answered on a Regional, sub-regional, and forest-level scale, because adaptive management strategies require determination that actions are taking place as described in the R6 2005 FEIS.

The GPNF and CRGNSA will contribute to compliance monitoring under the R6 2005 ROD as a part of Forest Plan Implementation monitoring. Regional Office staff will periodically aggregate this information as a part of program oversight.

An implementation/compliance monitoring database would track invasive plant treatment projects that are the subject of section 7 consultations under the ESA, generate annual reporting of compliance for use by the Services (NMFS and USFWS), and the FS, and allow for common reporting of data on individual projects. At a minimum, on each project requiring consultation, reporting will be required on compliance with Standards 16, 18, 19, and 20 in the R6 2005 ROD. Additional standards could be included, as appropriate. For example, Northwest Forest Plan (NWFP) riparian standards relevant to herbicide use.

Effectiveness Monitoring

The Effectiveness Monitoring component in the R6 2005 FEIS (USFW 2005a) is intended to answer the following questions:

- Have the number of new invasive plant infestations increased or decreased in the Region or at the project level?
- What changes in distribution, amount and proportion of invasive plant infestations have resulted due to treatment activities in the region or at the project level?
- Has the infestation size for a targeted invasive plant species been reduced regionally or at the project level?
- Which treatment methods, separate or in combination, are most successful for specific invasive species?
- Which treatment methods have not been successful for specific invasive species?

The nation-wide NRIS/Terra and the FACTS databases, provide common reporting formats to input information and provide a mechanism for addressing the above questions. In addition, current long-term ecological monitoring networks will assist the FS in determining trends of invasive plant infestations at the Regional level.

Monitoring that addresses the effectiveness of various measures designed to reduce potential adverse effects on listed species, from the project, including standards in the R6 2005 FEIS, PDC and "protection measures" would only be required for a representative sample of invasive plant treatment projects that pose a "high risk" to federally listed species. "High risk" projects are defined as projects with the potential to affect listed species, in the following situations:

- Any project involving aerial application of herbicide.
- Projects involving the use of heavy equipment or broadcast application of herbicide (e.g., boom spray or backpack spraying that is not limited to spot sprays) that occur in 1) riparian areas (as defined in NWFP, Pacfish, or Infish, as applicable), ditches or water corridors connected to habitat for listed fish; or, 2) proximity to federally listed plants or butterfly habitat.

No broadcast treatments would occur within 50 feet of any wet or dry stream, lake, or within any wetland with water present. Broadcast treatments would also not occur along roads that pose a high risk of herbicide delivery to surface waters, regardless of whether the road ditches are connected to habitat for listed fish or not. In addition, aerial application of herbicides is not part of this consultation.

However, broadcast applications of aquatic glyphosate and/or aquatic imazapyr may occur within a riparian area as defined in the NWFP. These treatments, along with herbicide treatment of wetland or stream emergent vegetation using spot or hand/selective methods, would be submitted as candidates for monitoring via the R6 2005 ROD Monitoring framework to ensure the design criteria for such treatments are effective.

Programmatic Project Consistency Reporting

The Action Agency is responsible for ensuring all individual actions taken under a programmatic consultation are carried out as described in that consultation with environmental results as predicted in that consultation. NMFS assists in this task by reviewing monitoring results to help action agencies ensure their projects do not jeopardize listed species or adversely modify or destroy their designated critical habitat. In the past, action agencies and NMFS have relied on periodic reporting, usually on batches of projects completed per year, after concluding programmatic consultation. To enable consistent reporting format, NMFS and action agencies have used forms agreed on by the agencies during consultation. For this consultation, GPNF and CRGNSA will use the Consultation Initiation and Reporting System (CIRS) for reporting on individual actions when that system becomes available.

<u>Activities Not Covered by this Consultation</u>

- Aerial Herbicide Application
- Herbicides other than the ten analyzed in this document
- Prescribed Burning
- Plowing/Tilling/Disking/Digging With Heavy Equipment
- Flooding/Drowning
- Foaming and Steaming

Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area is all of the acres in the watersheds of the GPNF and CRGNSA supporting listed fish that would be subject to site-specific treatments as well as EDRR management as described above. Those lands include 1,358,000 acres on the GPNF and the approximately 85,000 acres on the northern portion of the CRGNSA. The following fifth field watersheds contain listed fish: Wind River, Washougal River, East Fork Lewis River, Clearfork Cowlitz River, Upper Cowlitz River, Middle Cowlitz River, Upper Cispus River, Riffe Reservoir Cispus River, Tilton River, North Fork Toutle River, Green River, South Fork Toutle River, Upper Columbia River/Hood, Middle Columbia/Grays Creek, Lower Klickitat River, and Columbia Gorge tributaries Approximately 2710 acres (2,350 acres GPNF and 360 acres CRGNSA) have been identified as currently needing treatment under the proposed action. In addition, the action area includes stream reaches and stretches within the Columbia River and its watersheds up to 300 feet in length beyond the boundary of the GPNF and CRGNSA. This extension was incorporated to represent downstream effects where treatment sites are adjacent to the forest and scenic area boundaries. Indirect effects are not felt beyond this area because the proposed herbicides do not bioaccumulate.

Threatened Lower Columbia River Chinook salmon (LCC), Snake River spring/summer run Chinook salmon (SSC), Snake River fall run Chinook salmon (SFC), Lower Columbia River steelhead (LCS), Middle Columbia River steelhead (MCS), Snake River basin steelhead (SBS), Columbia River chum salmon (CC), and Lower Columbia River coho salmon (LCRC) use the action area to express some of their freshwater life histories (Good et al. 2005) (Table 8). In addition, endangered Upper Columbia River spring-run Chinook salmon (UCSC), Upper Columbia River steelhead (UCS), and Snake River sockeye salmon (SRS) use the action area to express some of their life histories (Table 8). NMFS designated critical habitat in the action area for ten of the eleven species (Table 8). The action area, except for areas above natural barriers to fish passage also contains EFH for Chinook and coho salmon (Pacific Fishery Management Council [PFMC] 1999), and is in an area where environmental effects of the proposed project may adversely affect EFH for this species.

Table 8. Federal Register Notices for Rules that list species, designate critical habitat, or apply protective regulations to Evolutionarily Significant Units (ESUs)/Distinct Population Segments (DPSs) considered in this consultation.

Species ESU/DPS	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)			
Lower Columbia River (LCC)	Threatened, 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630, (effective 1/02/06)	6/28/05; 70 FR 37160
Upper Columbia River spring-run (UCSC)	Endangered, 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630, (effective 1/02/06)	ESA section 9 applies
Snake River spring/summer run (SSC)	Threatened, 6/28/05; 70 FR 37160	10/25/99; 64 FR 57399	6/28/05; 70 FR 37160
Snake River fall run (SFC)	Threatened, 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	6/28/05; 70 FR 37160
Chum salmon (*O. keta*)			
Columbia Rive (CC)r	Threatened, 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630, (effective 1/02/06)	6/28/05; 70 FR 37160
Coho salmon (*O.kisutch*)			
Lower Columbia River (LCRC)	Threatened, 6/28/05; 70 FR 37160	Not applicable	6/28/05; 70 FR 37160
Steelhead (*O.mykiss*)			
Lower Columbia River (LCS)	Threatened; 1/05/06; 71 FR 834	9/02/05; 70 FR 52630, (effective 1/02/06)	6/28/05; 70 FR 37160
Middle Columbia River (MCS)	Threatened; 1/05/06; 71 FR 834	9/02/05; 70 FR 52630, (effective 1/02/06)	6/28/05; 70 FR 37160
Upper Columbia River (UCS)	Endangered; 1/05/06; 71 FR 834	9/02/05; 70 FR 52630, (effective 1/02/06)	ESA section 9 applies
Snake River basin (SBS)	Threatened; 1/05/06; 71 FR 834	9/02/05; 70 FR 52630, (effective 1/02/06)	6/28/05; 70 FR 37160
Sockeye salmon (*O.nerka*)			
Snake River (SRS)	Endangered, 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	ESA section 9 applies

ENDANGERED SPECIES ACT

Section 7(a) (2) of the ESA requires Federal agencies to consult with 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 habitat. This Biological Opinion (Opinion) records the results of the subject consultation. Section 7(b) (4) requires the provision of an incidental take statement (ITS) that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts. The ITS follows the Opinion in this document.

Biological Opinion

This Opinion presents the results of NMFS' consultation with GPNF and CRGNSA regarding whether the proposed action will jeopardize listed species or adversely modify or destroy their designated critical habitat. For the jeopardy analysis, NMFS reviews the status of each listed species of Pacific salmon and steelhead[3] considered in this consultation, the environmental baseline in the action area, the effects of the action, and cumulative effects (50 CFR 402.14(g)). From this assessment, NMFS discerns whether effects on individual animals in the action area are meaningful enough, in view of existing risks, to appreciably reduce the likelihood of the survival and recovery of the affected listed species.

For the critical habitat adverse modification analysis, NMFS considers the status of critical habitat, the functional condition of critical habitat in the action area (environmental baseline), the effects of the action on that level of function, and the cumulative effects. From this assessment, NMFS discerns whether any change in the function of the primary constituent elements (PCEs) of critical habitat in the action area is enough, in view of existing risks, to influence the function and conservation role of designated critical habitat. This analysis does not employ the regulatory definition of "destruction or adverse modification" at 50 CFR 402.02. Instead, this 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 for application of the "destruction or adverse modification" standard.[4]

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[3] "An 'evolutionarily significant unit' (ESU) of Pacific salmon (Waples 1991) and a distinct population segment (DPS) of steelhead (final steelhead FR notice) 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).

Status of the Species

To complete interagency consultation under ESA section 7, NMFS considers the status of each of the species likely to be adversely affected by any element of the proposed action. To make a determination on whether the proposed action will or will not jeopardize the continued existence of each affected species; NMFS considers the species' present prospects for long-term survival and the risks bearing on those prospects. Table 8 identifies the 11 ESUs of Pacific salmon and steelhead, and their designated critical habitat addressed in this Opinion.

There are a variety of ways to describe existing risk. NMFS reviews the range-wide status of the species affected by the proposed action using criteria that describe 'viable salmonid populations' (VSP) (McElhany et al. 2000). The attributes of viable salmonid populations include: abundance, productivity, spatial structure, and genetic diversity that maintain a species' capacity to adapt to various environmental conditions and allow it to 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 the functional condition of habitat such as that which might be adversely affected by the proposed action. The following definitions are generally accepted for the four VSP parameters found in McElhany et al. (2000):

- ***Abundance*** – Abundance is simply defined as the population size. This may reflect the number of spawning adults, the number of adults surviving to recruit to fisheries, the number of smolts emigrating from the system, or in other terms. Abundance is recognized as an important parameter because small populations are at greater risk of extinction than large populations, primarily because several processes that affect population dynamics operate differently in small populations than they do in large populations. Generally, the abundance of a VSP must be sufficient to: 1) provide the population a high probability of surviving observed environmental variation; 2) provide resilience to withstand changing conditions; 3) maintain genetic diversity; 4) to provide ecological functions throughout its life-cycle, and 5) to take into account uncertainty in population assessment.

- ***Productivity*** – Productivity is generally defined to be the growth rate of the population. Productivity is usually expressed as a ratio, for example, recruits/spawner. Recruits may be adults recruiting to a fishery, spawners, smolts, or other measure. For a VSP, the productivity should be sufficient to: 1) Maintain abundance above the viable level (in the absence of hatchery subsidy); 2) maintain abundance above the viable level, even during poor ocean conditions; 3) provide compensatory response at low population size.

- ***Spatial Structure*** – Population spatial structure affects evolutionary processes and may therefore alter a population's ability to respond to environmental change. A population's spatial structure depends fundamentally on habitat quality, spatial configuration, and dynamics as well as the dispersal characteristics of individuals in the population.

- ***Diversity*** – Variation has important effects on population viability. In a spatially and temporally varying environment, there are three general reasons why diversity is important for species and population viability. First, diversity allows species to use a wider array of environments than they could without it. Second, diversity protects a species against short-term spatial and temporal changes in the environment. Third, genetic diversity provides the raw material for surviving long-term environmental change.

The status of each species and the factos affecting their decline are described in NMFS Status Reviews for each species, ESA Critical Habitat Listings, and draft and final Recovery Plans (http://www.nwr.noaa.gov/ESA-Salmon-Regulations-Permits/index.cfm). The status of each species in Table 8 indicates that their biological requirements are currently not being met. Improvements in survival rates, over the entire life cycle, will be needed to meet species level biological requirements in the future. The following describes the major habitat limiting factors affecting VSP criteria, as well as the most current median population growth rates (lambda), and their 95 percent confidence intervals for each ESU covered in this Opinion.

Lower Columbia River Chinook salmon
The Lower Columbia River Salmon Recovery Plan identifies the following habitat limiting factors for recovery of the Washington Management Unit of the Lower Columbia/Willamette Chinook ESU: degraded floodplain and channel morphology; altered instream flows in tributaries; impaired fish passage in tributaries; excessive sediment and temperatures in tributaries; and degraded riparian habitat.

Historical Information. This ESU exhibits three major life history types: Fall-run, late fall-run, and spring-run and spans three ecological zones: Coastal (rain-driven hydrograph), Western Cascade (snow or glacial-driven hydrograph), and Gorge (transitioning to drier interior Columbia ecological zones). Historical records of Chinook salmon abundance are sparse, but cannery records suggest a peak run of 4.6 million fish in 1883. Although fall-run Chinook salmon are still present throughout much of their historical range, they are still subject to large scale hatchery production, relatively high harvest, and extensive habitat degradation. The Lewis River late fall Chinook population is the healthiest in the ESU and has a reasonable probability of being self-sustaining.

The spring-run populations are largely extirpated as the result of dams which block access to their higher elevation habitat. Abundances have largely declined since the last status review update (1998) and trend indicators for most populations are negative, especially if hatchery fish are assumed to have a reproductive success equivalent to that of natural-origin fish. However, 2001 abundance estimates increased for most LCC salmon populations over the previous few years and preliminary indications are that 2002 abundance also increased. The loss of fitness and diversity within the ESU is an important concern. In addition, the estimate over a base period from 1965 through 2000 yields a lambda of 0.99 (0.68 – 1.44 at the 95 percent confidence interval (CI)) (McClure et al. 2003) indicating a minimal increase in lambda needed to achieve 1 (lambda of 1 equals low extinction risk).

Upper Columbia River Spring-Run Chinook salmon
The Upper Columbia River Recovery Plan identifies the following habitat limiting factors for recovery of the Upper Columbia River Spring Chinook ESU: mortalities related to hydropower operations; impaired stream flows in tributaries; barriers to fish passage in tributaries; excessive sedimentation; degraded riparian habitat; degraded water quality and temperature; and altered floodplain and channel morphology.

The Upper Columbia River ESU includes spring-run Chinook populations found in Columbia River tributaries between Rock Island and Chief Joseph Dams, notably the Wenatchee, Entiat, and Methow River Basins. The populations are genetically and ecologically separate from the summer- and fall-run populations in the lower parts of many of the same river systems (Meyers et al. 1998). Although fish in this ESU are genetically similar to spring Chinook in adjacent ESUs, they are distinguished by ecological differences in spawning and rearing habitat preferences. For example, spring-run Chinook in upper Columbia River tributaries spawn at lower elevations (500 to 1,000 m) than in the Snake and John Day River systems.

Historical Information. The upper Columbia River populations were intermixed during the Grand Coulee Fish Maintenance Project (1939 through 1943), resulting in loss of genetic diversity between populations in the ESU. Homogenization remains an important feature of the ESU. Fish abundance has tended downward both recently and over the long term. At least six former populations from this ESU are now extinct, and nearly all extant populations have fewer than 100 wild spawners.

Access to a substantial portion of historical habitat was blocked by Chief Joseph and Grand Coulee Dams. There are local habitat problems related to irrigation diversions and hydroelectric development, as well as degraded riparian and instream habitat from urbanization and livestock grazing. Mainstem Columbia River hydroelectric development has resulted in a major disruption of migration corridors and affected flow regimes and estuarine habitat. Some populations in this ESU must migrate through nine mainstem dams.

Previous assessments of stocks within this ESU have identified several as being at risk or of concern. Given the lack of information on Chinook salmon stocks that are presumed to be extinct, the relationship of these stocks to existing ESUs is uncertain. Recent total abundance of this ESU is quite low, and escapements in 1994-1996 were the lowest in at least 60 years. At least six populations of spring Chinook salmon in this ESU have become extinct, and almost all remaining naturally spawning populations have fewer than 100 spawners. The estimate over a base period from 1965 through 2000 yields a lambda of 0.85 (0.62 – 1.17 at the 95 percent C) (McClure et al. 2003) indicating a 17 percent increase in lambda needed to achieve 1 (lambda of 1 equals low extinction risk). In 2002, the spring Chinook count at Priest Rapids Dam was 34,083 with 24,000 arriving at Rock Island Dam. The 2002 count was about 67.6 percent and 242 percent of the respective 2001 and 10-year average adult spring Chinook count at Priest Rapids Dam. Numbers of wild Chinook in tributaries located above Rock Island Dam were reported to still be at low levels (FPC 2003).

Snake River Spring/Summer Run Chinook salmon
The Snake River Recovery Plan identifies the following habitat limiting factors for recovery of the Washington MPG of the Snake River spring/summer Chinook salmon ESU: reduced instream flows; excessive sediment; elevated water temperatures; altered channel morphology; degraded riparian habitat; and fish passage blockages.

Historical Information. Historically, Snake River spring- and/or summer-run Chinook salmon spawned in virtually all accessible and suitable habitats in the Snake River system (Fulton 1968). During the late 1800s, the Snake River produced a substantial fraction of all Columbia Basin spring and summer Chinook salmon, with total production probably exceeding 1.5 million in some years. By the mid-1900s, the abundance of adult spring and summer Chinook salmon had greatly declined. Fulton (1968) estimated that an average of 125,000 adults per year entered the Snake River tributaries from 1950 through 1960. As evidenced by adult counts at dams, however, spring and summer Chinook salmon have declined considerably since the 1960s.

Recent trends in redd counts in major tributaries of the Snake River indicate that many subpopulations could be at critically low levels. Subpopulations in the Grande Ronde River, Middle Fork Salmon River, and Upper Salmon River Basins are at particularly high risk. Both demographic and genetic risks would be of concern for such subpopulations, and in some cases, habitat may be so sparsely populated that adults have difficulty finding mates. The estimate over a base period from 1965 through 2000 yields a lambda of 0.97 (0.89 – 1.06 at the 95 percent CI) (McClure et al. 2003) indicating a three percent increase in lambda needed to achieve 1 (lambda of 1 equals low extinction risk). In 2002, the fish count at Lower Granite Dam was 75,025, more than double the 10-year average. Estimated hatchery Chinook at Lower Granite Dam accounted for a minimum of 69.7 percent of the run. The spring Chinook count in the Snake River was at the all-time low of about 1,500 as recently as 1995, but in 2001 and 2002 both hatchery and wild/natural returns to the Snake River increased (FPC 2003).

Snake River Fall-Run Chinook salmon
The Snake River Recovery Plan identifies the following habitat limiting factors for recovery of the Washington major population groups (MPG) of the Snake River fall Chinook salmon ESU: impaired stream flows; barriers to fish passage in tributaries; excessive sediment; degraded water quality and temperatures; altered floodplain and channel morphology; degraded riparian habitat; and fish passage blockages in tributaries.

Historical Information. Snake River fall-run Chinook salmon remained stable at high levels of abundance through the first part of the 20th century, but then declined substantially. Although the historical abundance of fall-run Chinook salmon in the Snake River is difficult to estimate, adult returns appear to have declined by three orders of magnitude since the 1940s, and perhaps by another order of magnitude from pristine levels. Irving and Bjornn (1981) estimated that the mean number of fall-run Chinook salmon returning to the Snake River declined from 72,000 during the period 1938 to 1949, to 29,000 during the 1950s. Further declines occurred upon completion of the Hells Canyon Dam complex, which blocked access to primary production areas in the late 1950s. Estimated returns of naturally produced adults from 1985 through 1993 range from 114 to 742 fish (USEPA 1998).

Almost all historical Snake River fall-run Chinook salmon spawning habitat in the Snake River Basin was blocked by the Hells Canyon Dam complex; other habitat blockages have also occurred in Columbia River tributaries. The ESU's range has also been affected by agricultural water withdrawals, grazing, and vegetation management. The continued straying by nonnative hatchery fish into natural production areas is an additional source of risk. Assessing extinction risk to the newly configured ESU is difficult because of the geographic discontinuity and the disparity in the status of the two remaining populations. The relatively recent extirpation of fall-run Chinook in the John Day, Umatilla, and Walla Walla Rivers is also a factor in assessing the risk to the overall ESU. Long-term trends in abundance for specific tributary systems are mixed. For the Snake River fall-run Chinook salmon ESU, the estimate over a base period from 1965 through 2000 yields a lambda of 0.95 (0.76 – 1.18 at the 95 percent CI) (McClure et al. 2003) indicating a five percent increase in lambda needed to achieve 1 (lambda of 1 equals low extinction risk). The Snake River component of the fall Chinook run has been increasing during the past few years as a result of hatchery and supplementation efforts in the Snake and Clearwater River Basins. In 2002, more than 15,200 fall Chinook were counted past the two lower dams on the Snake River, with about 12,400 counted above Lower Granite Dam. These adult returns are about triple the 10-year average at these Snake River projects (FPC 2003).

Columbia River Chum Salmon
The Lower Columbia River Salmon Recovery Plan identifies the following habitat limiting factors for recovery of the Columbia chum salmon ESU: loss of estuary/ nearshore/ freshwater habitat; degraded floodplain and channel morphology; altered instream flows in tributaries; impaired fish passage in tributaries; excessive sediment and temperatures in tributaries; and degraded riparian habitat.

Historical Information. Historically, the Columbia River chum salmon ESU supported a large commercial fishery in the first half of this century, landing more than 500,000 fish per year as recently as 1942. Commercial catches declined beginning in the mid-1950s and in later years rarely exceeded 2,000 per year. Presently there are no recreational or directed commercial fisheries for chum salmon in the Columbia River, although chum salmon are taken incidentally in the gill-net fisheries for coho and Chinook salmon, and some tributaries have a minor recreational harvest (WDF et al. 1993). Observations of these fish still occur in most of the thirteen basins/areas that were identified in 1951 as hosting chum salmon. However, there are usually very few fish observed in these areas. In 1999, the Washington State Department of Fish and Wildlife located another Columbia River mainstem spawning area for chum salmon located near the I-205 Bridge (WDFW 2000).

Current abundance is probably less than 1% of historic levels, and the ESU has undoubtedly lost some (perhaps much) of its original genetic diversity. Presently, only three chum salmon populations, all relatively small and all in Washington State, are recognized and monitored in the Columbia River (Grays River, Hardy and Hamilton Creeks). Each of these populations may have been influenced by hatchery programs and/or introduced stocks, but information on hatchery-wild interactions is unavailable (Johnson et al. 1997). The estimates over a base period from 1965 through 2000 of six populations yields a lambda range of 0.92 to 1.23 (McClure et al. 2003) indicating a minimal increase in lambda for most populated needed to achieve 1 (lambda of 1 equals low extinction risk).

Lower Columbia River Coho salmon
The Lower Columbia River Salmon Recovery Plan identifies the following habitat limiting factors for recovery of the Washington Management Unit of the Lower Columbia/Willamette coho salmon ESU: degraded floodplain and channel morphology; altered instream flows in tributaries; impaired fish passage in tributaries; excessive sediment and temperatures in tributaries; and degraded riparian habitat.

Historical Information. Prior to the 1900s, naturally produced coho salmon were widespread in the Columbia River Basin, with the historical center of abundance in the Lower Columbia River. Columbia and Snake River runs were drastically reduced or destroyed by various factors prior to the 1950s including over harvest, habitat destruction or barriers to habitat. The drastic decline in populations initiated the widespread hatchery enhancement program after 1960. This program increased coho salmon populations in the Columbia River to historic levels. The causes of the original declines to coho were not eliminated by this extensive hatchery production.

Over harvest, habitat blockages and destruction, and other detrimental activities continued. This resulted in a continued decline in naturally spawning runs while exploitation of hatchery fish continued at increased levels. In the early 1980s, it was estimated that less than 25,000 coho were spawning naturally in the Columbia River Basin. These fish were thought to have been mainly feral hatchery fish and adult returns from hatchery out-plants in streams away from hatcheries, although some were naturally produced fish.

Currently, NMFS has identified only 2 populations of Lower Columbia River coho, the Clackamas and Sandy Rivers that demonstrate appreciable levels of natural production. There is only limited information on the remainder of the 21 putative populations, but most were considered extirpated, or nearly so, during the low marine survival period of the 1990s. Recently initiated spawner surveys by Oregon Department of Fish and Wildlife and juvenile outmigrant data by WDFW indicate there is some natural coho salmon production. However, hatchery-origin spawners dominate the majority of populations, and little data indicates they would naturally persist in the long-term. Of the two populations where natural production can be evaluated, both have experienced recruitment failure over the last decade. Recent abundances of the two populations are relatively low, placing them in a range where environmental, demographic, and genetic stochasticity can be significant risk factors.

The most serious overall concern was the scarcity of naturally produced spawners throughout the ESU, 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 Rivers), short- and long-term trends are negative and productivity is down sharply. On the positive side, adult returns in 2000 and 2001 were up noticeably in some areas, and evidence for limited natural production has been found in some areas outside the Sandy and Clackamas. The paucity of naturally produced spawners in this ESU can be contrasted with the very large number of hatchery produced adults.

Snake River Sockeye salmon
The only remaining anadromous sockeye in the Snake River system are found in Redfish Lake, on the Salmon River. The non-anadromous form (kokanee) found in Redfish Lake and elsewhere in the Snake River basin, is included in the ESU. Snake River sockeye were historically abundant in several lake systems of Idaho and Oregon. However, all populations have been extirpated in the past century, except fish returning to Redfish Lake.

Historical Information. In 1910, impassable Sunbeam Dam was constructed 20 miles downstream of Redfish Lake. Although several fish ladders and a diversion tunnel were installed during subsequent decades, it is unclear whether enough fish passed above the dam to sustain the run. The dam was partly removed in 1934, after which Redfish Lake runs partially rebounded. Evidence is mixed as to whether the restored runs constitute anadromous forms that managed to persist during the dam years, non-anadromous forms that became migratory, or fish that strayed in from outside the ESU.

Historically, the largest numbers of Snake River sockeye salmon returned to headwaters of the Payette River, where 75,000 were taken one year by a single fishing operation in Big Payette Lake. During the early 1880s, returns of Snake River sockeye salmon to the headwaters of the Grande Ronde river in Oregon (Walleye Lake) were estimated between 24,000 and 30,000 at a minimum (Cramer, 1990). During the 1950s and 1960s, adult returns to Redfish Lake numbered more than 4,000 fish.

Snake River sockeye salmon returns to Redfish Lake since at least 1985, when the Idaho Department of Fish and Game began operating a temporary weir below the lake, have been extremely small (one to 29 adults counted per year). NMFS proposed an interim recovery level of 2,000 adult Snake River sockeye salmon in Redfish Lake and two other lakes in the Snake River basin. Because only 16 wild and 264 hatchery-produced adult sockeye returned to the Stanley River basin between 1990 and 2000, NMFS considers the risk of extinction of this ESU to be very high. In 2002, 52 adult sockeye were counted at Lower Granite Dam (FPC 2003). In September 2003, 12 sockeye salmon were counted at Lower Granite Dam on the Snake River.

Lower Columbia River steelhead
The Lower Columbia River Salmon Recovery Plan identifies the following habitat limiting factors for recovery of the Washington Management Unit of the Lower Columbia/Willamette steelhead ESU: degraded floodplain and channel morphology; altered instream flows in tributaries; impaired fish passage in tributaries; excessive sediment and temperatures; and degraded riparian habitat.

Historical Information. All runs in the Lower Columbia River steelhead ESU have declined over the past 20 years, with sharp declines in the last 5 years. Historic counts in some of the larger tributaries (Cowlitz, Kalama, and Sandy rivers) probably exceeded 20,000 fish; more recent counts have been in the range of 1,000 to 2,000 fish (NMFS 2000).

Habitat loss, hatchery steelhead introgression, and harvest are the major contributors to the decline of steelhead in this ESU. For the Lower Columbia River steelhead ESU, NMFS (2000) estimates that the median population growth rate over the base period (1990-1998) ranges from 0.98 to 0.78, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to that of fish of wild origin. The estimate over a base period from 1965 through 2000 yields a lambda of 0.96 (0.94 – 0.98 at the 95 percent CI) (McClure et al. 2003) indicating a four percent increase in lambda needed to achieve 1 (lambda of 1 equals low extinction risk).

Middle Columbia River steelhead
The Yakima River Salmon Recovery Plan identifies the following habitat limiting factors for recovery of the Middle Columbia River steelhead ESU: reduced instream flows in tributaries; impaired fish passage in tributaries; excessive sediment; degraded water quality – including elevated stream temperatures; degraded floodplain and channel morphology; and degraded riparian habitat.

Historical Information. Estimates of historical (pre-1960s) abundance specific to this ESU are available for the Yakima River, which has an estimated run size of 100,000 (WDF et al. 1993). Assuming comparable run sizes for other drainage areas in this ESU, the total historical run size may have exceeded 300,000 steelhead (NMFS 2005a).

Current population sizes are substantially lower than historic levels, especially in the rivers with the largest steelhead runs in the ESU, the John Day, Deschutes, and Yakima Rivers. At least two extinctions of native steelhead runs in the ESU have occurred (the Crooked and Metolius Rivers, both in the Deschutes River Basin). For the Mid Columbia River steelhead ESU as a whole, the estimate over a base period from 1965 through 2000 yields a lambda of 0.94 (0.69 – 1.27 at the 95 percent CI) (McClure et al. 2003) indicating a six percent increase in lambda needed to achieve 1 (lambda of 1 equals low extinction risk). In 2002, the count of Bonneville Dam steelhead totaled 481,036 and exceeded all counts recorded at Bonneville Dam since 1938, except the 2001 total which was 633,464. Of the total return in 2002, 143,032 were considered wild steelhead (FPC 2003).

Upper Columbia River steelhead
The Upper Columbia River Salmon Recovery Plan identifies the following habitat limiting factors for recovery of the Upper Columbia River steelhead ESU: reduced instream flows in tributaries; impaired fish passage in tributaries; excessive tributary sediment; degraded water quality; degraded floodplain and channel morphology, and degraded riparian habitat.

Historical Information. Estimates of historical (pre-1960s) abundance specific to this ESU are available from fish counts at dams (NMFS 2005a). Counts at Rock Island Dam from 1933 to 1959 averaged 2,600 to 3,700, suggesting a pre-fishery run size exceeding 5,000 adults for tributaries above Rock Island Dam (Chapman et al. 1994). Lower Columbia River harvests had already depressed fish stocks during the period these counts were taken, thus, the pre-fishery estimate should be viewed with caution.

The estimate over a base period from 1965 through 2000 yields a lambda of 1.00 (0.66 – 1.52 at the 95 percent confidence interval (CI)) (McClure et al. 2003) indicating a low extinction risk. In 2002, 15,286 steelhead were counted at Rock Island Dam, compared to the 2001 count of 28,602 and the 10-year average return of 9,165. Of the total steelhead counted at Rock Island Dam in 2002, 10,353 were wild (non-clipped adipose fin) steelhead (FPC 2003).

Snake River Basin steelhead
The Snake River Recovery Plan identifies the following habitat limiting factors for recovery of the Washington Major Population Groups (MPG) of the Snake River steelhead ESU: reduced instream flows, excessive sediment, elevated water temperatures, altered channel morphology, degraded riparian habitat, and fish passage blockages.

Historical Information. The longest consistent indicator of steelhead abundance in the Snake River basin is derived from counts of natural-origin steelhead at the uppermost dam on the lower Snake River. According to these estimates, the abundance of summer steelhead has declined from a 4-year average of 58,300 in 1964 to a 4-year average of 8,300 ending in 1998 (NMFS 2000). In general, steelhead abundance declined sharply in the early 1970's, rebounded moderately from the mid 1970's through the 1980's, and declined again during the 1990's.

For the Snake River steelhead ESU as a whole, the estimate over a base period from 1965 through 2000 yields a lambda of 0.96 (0.84 – 1.10 at the 95 percent confidence interval (CI)) (McClure et al. 2003) indicating a four percent increase in lambda needed to achieve 1 (lambda of 1 equals low extinction risk). The main contributor of steelhead in the Columbia River basin is the Snake River. In 2002, the turnout into the Snake River was about 210,000, or 71 percent of the total counted at McNary Dam (286,805). The 2002 Snake River steelhead count was about twice the 10-year average. The number of wild steelhead (non-clipped adipose fin) increased to about a 55,000 average in the Snake River in 2002 (FPC 2003).

Salmonid Habitat Use in the Columbia River. Adult salmonids migrate and spawn in the main channel of the Columbia River. Mainstem spawning (chum salmon, coho, and Chinook salmon) is limited to a few reaches between river mile (RM) 113 to RM 142. Adult salmonids generally migrate mid-channel and occur throughout the water column at depths ranging from 1 to 50 feet, although most adult salmonids are likely to be present in the upper 25 feet of the water column. Juveniles (minus 1 age class) generally use near-shore and off-channel habitats and occur throughout the water column at depths ranging from 1 to 20 feet. Juveniles (plus 1 age class) tend to use nearshore, off-channel, mid-channel, and deeper water habitats, and occur throughout the water column at depths ranging from 1 to 33 feet. A study by Carlson et al. (2001) on fish behavior and distribution in the lower Columbia River consistently found juvenile salmonids using water column depths ranging from 22 to 37 feet.

Furthermore, a variety of factors lead to the complexity and variability in the vertical distribution of juvenile salmonids. Those are diel periodicity (Beeman et al. 2003), food availability (Groot and Margolis 1991), size (Bottom et al. 2001), predation risks, and species specific behavior. Based on migratory and residence time, ESA-listed salmon and steelhead species (Table 9) will be present in the action area during periods of invasive weed treatment.

Table 9. Migration and rearing timing for Columbia and Snake River Salmonids

		Calendar Year (month)											
		J	F	M	A	M	J	J	A	S	O	N	D
Chinook	Juvenile rearing												
	Juvenile and adult migration												
	Peak smolt out-migration												
	Peak adult emigration												
Chum	Juvenile rearing												
	Juvenile and adult migration												
	Peak smolt out-migration												
	Peak adult emigration												
Coho	Juvenile rearing												
	Juvenile and adult migration												
	Peak smolt out-migration												
	Peak adult emigration												
Sockeye	Juvenile rearing												
	Juvenile and adult migration												
	Peak smolt out-migration												
	Peak adult emigration												
Steelhead	Juvenile rearing												
	Juvenile and adult migration												
	Peak smolt out-migration												
	Peak adult emigration												

Status of Critical Habitat

The status of designated critical habitat considers the range-wide condition and trends of those physical and biological features that are essential to the conservation of a given species, referred to as the "Primary Constituent Elements" (PCEs) (Table 10) and that may require special management considerations or protection (50 CFR 424.12(b)). Of the 11 ESUs addressed in this Opinion, critical habitat has been designated for all but one (LCRC). Many of the ESUs share the same river and creek systems, have similar life history characteristics, and therefore, require many of the same PCEs.

Table 10. Essential physical and biological features named as PCEs in all salmon critical habitat designations.

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[b]	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.

The relevant PCEs for this consultation area limited to those supporting the freshwater life histories the 10 ESUs. The rangewide functional condition of those PCEs is generally diminished and rangewide limiting factors include disconnected floodplains (rearing and migration PCEs), altered and simplified channel structure (rearing, migration, and spawning PCEs), diminished riparian habitat and watershed processes (spawning, rearing, and migration PCEs), altered instream flow (spawning, rearing and migration PCEs). Short explanations of the effect of each limiting factor are summarized below.

- Floodplain disconnectivity and channel simplification is widespread in the ESUs, causing diminished space for spawning and rearing capacity, increased egg and alevin death during incubation, and loss of juvenile rearing refugia from predation and high instream flow.
- Historic forest practices allowing timber harvest and related management activity within the riparian zone has affected the riparian processes that make and maintain shade, bank stability, intercept overland sediment flow, and contribute food and recruitable large wood in streams. Loss of these functions diminishes the capacity and condition of salmon spawning, incubation, and rearing areas. This factor is prevalent throughout the range of many ESUs and causes destabilization of streambeds and channels, leading to loss of rearing refugia and killing eggs during incubation.

- Human land use activities enable erosion and transport of sediment to streams. In turn, water quality diminished from turbidity, and deposition leads to streambed aggradation. These changes affect the availability of food items, the condition of spawning areas, and the survival of incubating eggs and alevins.
- Instream flows and changed hydrology affect those ESUs that migrate in summer and spawn in lower stream channels. Excessively low flows resulting from water withdrawals or wetlands loss limit access to spawning streams and/or to suitable spawning sites, and restricts spawning to unprotected main-channel areas that are highly vulnerable to scour during freshets. In addition, altered summer low flows lead to excessively high water temperatures that adversely affect adult fish migration, rearing and incubation success. Finally, increases in the magnitude, frequency and duration of peak flow events resulting from man-caused hydrologic alterations adversely affect salmonid survival during incubation.

To assist NMFS during the designation of critical habitat, NMFS convened several Critical Habitat Analytical Review Teams (CHARTs). The CHARTs, organized by major geographic domains that roughly correspond to recovery planning domains, consisted of federal salmonid biologists and habitat specialists tasked with assessing biological information pertaining to areas under consideration for designation. The CHARTs explored a variety of data sources and used their best professional judgment to: 1) determine if occupied areas contained PCEs essential for conservation; 2) determine whether there were any unoccupied areas within the historical range of the listed salmon and steelhead that may be essential for conservation; 3) score each habitat area based on several factors related to the quantity and quality of the physical and biological features; 4) rate each habitat area as having a ''high,'' ''medium,'' or ''low'' conservation value; 5) identified management actions that could affect salmonid habitat in given areas.[5] The CHART ratings for each of the watersheds in the action area are listed in the section below.

Lower Columbia River Chinook

The critical habitat for LCC salmon was initially designated on February 16, 2000 (65 FR 7764), but was withdrawn in April 2002. The initial designation included all river reaches accessible to Chinook salmon in Columbia River tributaries between the Grays and White Salmon Rivers in Washington and the Willamette and Hood Rivers in Oregon, inclusive. Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to The Dalles Dam. Excluded were the areas above specific dams (Condit, Dalles, Bull Run Dam 2, and Merwin Dam) and areas above longstanding, naturally impassable barriers (e.g., natural waterfalls in existence for at least several hundred years). Critical habitat designation for this ESU was finalized 09/02/05 (70 FR 52630). As in other ESUs, Chinook salmon have been affected by the alteration of freshwater habitat (Bottom et al. 2001, WDF et al. 1993, Kostow 1995). Timber harvesting and associated road building

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

peaked in the 1930s, but effects from the timber industry remain (Kostow 1995). Agriculture is widespread in this ESU and has affected riparian vegetation and stream hydrology. The ESU is also highly affected by urbanization, including river diking and channelization, wetland draining and filling, and pollution (Kostow 1995).

The CHART assessment for this ESU addressed 10 subbasins containing 47 occupied watersheds, as well as the Columbia River rearing/migration corridor. Subbasins were chosen as freshwater critical habitat units because they present a convenient and systematic way to organize the CHART's watershed assessment for this ESU. Of the subbasins in the action area that contain listed fish the CHART determined the following conservation values:

Wind River (HUC5 1707010511) was given a high conservation value as this HUC5 contains habitat that still supports one of four Technical Recovery Team (TRT) historical fall-run populations (including a core population) in the Columbia River Gorge area. Passage over Shipherd Falls provides access to relatively extensive spring-run habitat for this region. The PCEs overlap with a Forest Ecosystem Management Assessment Team (FEMAT) key watershed for at-risk anadromous salmonids (NMFS 2004, FEMAT 1994).

Middle Columbia/Grays Creek (HUC5 1707010512) was given a medium conservation value as the PCEs in this HUC5 are limited and likely always were due to gradient barriers and a small drainage size. This HUC5 supports a TRT historical core fall-run population but the production is low. However, the mainstem Columbia River is a high value connectivity corridor (NMFS 2004).

Washougal River (HUC5 1708000106) was given a medium conservation value as the HUC5 was not identified as a core or genetic legacy population by the TRT (NMFS 2004).

Columbia Gorge Tributaries (HUC5 1708000107) was given a high conservation value as the tributary habitat in this HUC5 supports at least one TRT historical core fall-run population. The mainstem Columbia River is high value connectivity corridor supporting all upstream populations (NMFS 2004).

East Fork Lewis River (HUC5 1708000204) was given a high conservation value as the PCEs support fall-run fish and the TRT identified this HUC5 as supporting a genetic legacy population. The uppermost areas in this HUC5 are a FEMAT key watershed for at-risk anadromous salmonids and this HUC5 contains some of the best remaining habitat (NMFS 2004, FEMAT 1994).

Headwaters Cowlitz River (HUC5 1708000401), Upper Cowlitz River (HUC5 1708000402), and Cowlitz Valley Frontal (HUC5 1708000403) were given high conservation values as the PCEs support spring- and fall-run fish via trap and haul. The HUC5s were given this score due to the importance of the historic habitat to promote conservation of the ESU (NMFS 2004).

Upper Cispus River (HUC5 1708000404) and Lower Cispus River (HUC5 1708000405) were given high conservation values as the PCEs support spring- and fall-run fish via trap and haul. The HUC5s were given this score due to the importance of the historic habitat to promote conservation of the ESU and the identification of the Cispus River by the TRT as a core spring-run population (NMFS 2004).

Tilton River (HUC5 1708000501) was given a medium conservation value as the PCEs support spring- and fall-run fish via trap and haul, and the HUC5 is only habitat for a TRT historical spring-run population (NMFS 2004).

Riffe Reservoir (HUC5 1708000501) was given a high conservation value as the PCEs support spring- and fall-run fish via trap and haul. However, the PCEs are degraded due to inundation. Nonetheless, the HUC5 is primarily important as a rearing/migration corridor for upstream populations (NMFS 2004).

North Fork Toutle River (HUC5 170800504) was given a medium conservation value as the PCEs support a spring- and fall-run TRT population. PCEs in this HUC5 are very limited, yet the CHART noted recolonization of this area despite volcano-related impacts on the PCEs (NMFS 2004).

Green River (HUC5 1708000505) and South Fork Toutle River (HUC5 1708000506) were given high conservation values as the PCEs support a spring- and fall-run TRT population. Most of the spawning PCEs for these populations may be in these HUC5s. The CHART also noted recolonization of these areas despite volcano-related impacts on the PCEs (NMFS 2004).

Upper Columbia River Spring Chinook

The critical habitat for Upper Columbia River Chinook salmon was initially designated on February 16, 2000 (65 FR 7764), but was withdrawn in April 2002. The initial designation included all river reaches accessible to listed Chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington. Excluded were the areas above Chief Joseph Dam and areas above longstanding, naturally impassable barriers (e.g., natural waterfalls in existence for at least several hundred years). The final rule designating critical habitat for this ESU was published on September 2, 2005 (70 FR 52630).

Spawning and rearing habitat in the Columbia River and its tributaries upstream of the Yakima River includes dry areas where conditions are less conducive to Chinook survival than in many other parts of the Columbia River Basin (Mullan et al. 1992). Salmon in this ESU must pass up to nine federal and private dams, and Chief Joseph Dam prevents access to historical spawning grounds farther upstream. Degradation of remaining spawning and rearing habitat continues to be a major concern associated with urbanization, irrigation projects, and livestock grazing along riparian corridors.

The CHART assessment for this ESU addressed four subbasins containing 15 occupied watersheds, as well as the Columbia River rearing/migration corridor. Subbasins were chosen as freshwater critical habitat units because they present a convenient and systematic way to organize the CHART's watershed assessments for this ESU. The Interior Columbia Basin Technical Recovery Team did not identify separate major groupings/strata for this ESU due to the relatively small size of the area. Therefore, as part of its assessment the CHART considered the conservation value of each HUC5 in the context of a single population group. The relevant critical habitat unit for this consultation is the Columbia River corridor from Rock Island Dam downstream to the Pacific Ocean. After reviewing the best available scientific data for all of the areas within the freshwater and estuarine range of this ESU, the CHART concluded that the Columbia River corridor was of high conservation value to the ESU. The CHART noted that this corridor connects every watershed and population in this ESU with the ocean and is used by rearing/migrating juveniles and migrating adults. The Columbia River estuary is a particularly important area for this ESU as both juveniles and adults make the critical physiological transition between life in freshwater and marine habitats.

Snake River Spring/Summer Chinook
The critical habitat for the Snake River spring/summer Chinook salmon was listed on December 28, 1993 (58 FR 68543). Designated critical habitat consists of the water, waterway bottom, and adjacent riparian zone of specified lakes and river reaches in hydrologic units presently or historically accessible to listed Snake River salmon (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams). In general, the habitats used for spawning and early juvenile rearing are different among the three Chinook salmon forms (spring, summer, and fall) (Chapman et al. 1991, as cited in Meyers 1998). In both the Columbia and Snake Rivers, spring Chinook salmon tend to use small, higher elevation streams (headwaters), and fall Chinook salmon tend to use large, lower elevation streams or mainstem areas. Summer Chinook are more variable in their spawning habitats; in the Snake River, they inhabit small, high elevation tributaries typical of spring Chinook salmon habitat, whereas in the upper Columbia River they spawn in the larger lower elevation streams characteristic of fall Chinook salmon habitat. Differences are also evident in juvenile out-migration behavior. In both rivers, spring Chinook salmon migrate swiftly to sea as yearling smolts, and fall Chinook salmon move seaward slowly as subyearlings. Summer Chinook salmon in the Snake River resemble spring-run fish in migrating as yearlings, but migrate as subyearlings in the upper Columbia River. Early researchers categorized the two behavioral types as "ocean-type" Chinook for seaward migrating subyearlings and as "stream-type" Chinook for the yearling migrants (Gilbert 1912).

Snake River Fall Chinook
The critical habitat for the Snake River fall Chinook salmon was listed on December 28, 1993 (58 FR 68543) and modified on March 9, 1998 (63 FR 11515) to include the Deschutes River. With hydro development, historically the most productive areas of the Snake River Basin are now inaccessible or inundated. The upper reaches of the mainstem Snake River were the primary areas used by fall-run Chinook salmon, with only limited spawning activity reported downstream. The construction of Brownlee Dam (1958), Oxbow Dam (1961), and Hells Canyon Dam (1967) eliminated the primary production areas of Snake River fall-run Chinook salmon. There are now 12 dams on the mainstem Snake River, and they have substantially reduced the distribution and abundance of fall-run Chinook salmon (Irving and Bjornn 1981).

Columbia River chum

The critical habitat for Columbia River chum salmon was initially designated on February 16, 2000 (65 FR 7764), but was withdrawn in April 2002. The initial designation included all river reaches accessible to listed chum salmon (including estuarine areas and tributaries) in the Columbia River downstream of Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at Rkm 144 near the town of St. Helens. Excluded were the areas above Bonneville and Merwin Dams and areas above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). The final critical habitat was designated 09/02/05 (70 FR 52630).

The CHART assessment for this ESU addressed six subbasins containing 19 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Subbasins were chosen as freshwater critical habitat units because they present a convenient and systematic way to organize the CHART's watershed assessments for this ESU. Of the subbasins in the action area that contain listed fish the CHART determined the following conservation values:

Middle Columbia/Grays Creek (HUC5 1701010512) was given a high conservation value as the CHART concluded that there were no low conservation value HUC5s since the ESU as a whole had extremely limited distribution of spawning/rearing PCEs. No tributary or spawning habitat was identified in this HUC5 but the CHART concluded that the Columbia Rearing rearing/migration PCEs in this HUC5 downstream from the Big White Salmon River are of high conservation value to the ESU (NMFS 2004).

Columbia Gorge Tributaries (HUC5 1708000107) was given a high conservation value as the CHART concluded that there were no low conservation value HUC5s since the ESU as a whole had extremely limited distribution of spawning/rearing PCEs. This HUC5 is within the range of the TRT historical Lower Gorge Tributaries population and contains essential tributary spawning sites as well as mainstream Columbia River spawning sites in the vicinity of Hardy and Hamilton Creeks and downstream of Camas, Washington. The HUC5 also contains important springs/seeps and is a high value Columbia River rearing/migration corridor for the ESU (NMFS 2004).

East Fork Lewis River (HUC5 1708000205) was given a high conservation value as the CHART concluded that there were no low conservation value HUC5s since the ESU as a whole had extremely limited distribution of spawning/rearing PCEs. The HUC5 is one of two supporting a TRT historical core population. The East Fore Lewis River is noted as having seeps or springs that may be important for this ESU (NMFS 2004).

Green River (HUC5 1708000505) and South Fork Toutle River (HUC5 1708000506) were given medium conservation values as the CHART concluded that there were no low conservation value HUC5s since the ESU as a whole had extremely limited distribution of spawning/rearing PCEs and these HUC5 had one of the lowest (NMFS 2004).

Snake River sockeye

The critical habitat for the Snake River sockeye salmon was designated on December 28, 1993 (58 FR 68543). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, Alturas Lake Creek, Valley Creek, and Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks). Snake River sockeye salmon have a very limited distribution relative to critical spawning and rearing habitat. Redfish Lake represents only one of the five Stanley Basin lakes historically occupied by Snake River sockeye salmon and is designated as critical habitat for the species.

Lower Columbia River steelhead
The critical habitat for Lower Columbia River steelhead was designated on February 16, 2000 (65 FR 7764). The designated critical habitat consisted of all river reaches accessible to listed steelhead in Columbia River tributaries between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers ion Oregon, inclusive. Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the Hood River. Excluded were areas above the Bull Run 2 and Merwin Dams and areas above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). The final critical habitat was designated 09/02/05 (70 FR 52630).

Steelhead in this DPS are thought to use estuarine habitats extensively during outmigration, smoltification, and upstream spawning migrations. The lower reaches of the Columbia River are highly modified by urbanization and dredging for navigation. The upland areas covered by this DPS are extensively logged, affecting water quality in the smaller streams used primarily by summer runs. In addition, all major tributaries used by LCR steelhead have some form of hydraulic barrier that impedes fish passage. Barriers range from impassible structures in the Sandy River basin that block access to extensive, historically occupied, steelhead habitat, to passable but disruptive projects on the Cowlitz and Lewis rivers (NMFS 2005a).

The CHART assessment for this DPS addressed nine subbasins containing 41 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Subbasins were chosen as freshwater critical habitat units because they present a convenient and systematic way to organize the CHART's watershed assessments for this DPS. Of the subbasins in the action area that contain listed fish the CHART determined the following conservation values:

Wind River (HUC5 1707010511) was given a high conservation value, the highest HUC5 score for the entire DPS. The PCEs support one of three summer-run and one of three winter-run TRT historical populations in the Gorge region. Passage over Shipherd Falls improved access to extensive summer- and winter-run habitat in the Gorge region. The PCEs overlap with a FEMAT kep watershed for at-risk anadromous salmonids (NMFS 2004, FEMAT 1994).

Middle Columbia/Grays Creek (HUC5 1707010512) was give a low conservation value and the PCEs are limited in this HUC5 and likely always were due to gradient barriers and small drainage size. The HUC5 supports a TRT historical winter-run population but production was likely low. The mainstem Columbia River is a high value connectivity corridor (NMFS 2004).

Washougal River (HUC5 1708000106) was given a high conservation value as the extensive PCEs support a TRT core and genetic legacy summer-run population as well as a winter-run population (NMFS 2004).

Columbia Gorge Tributaries (HUC5 1708000107) was given a medium conservation value as the tributary habitat in the HUC5 supports at least one TRT historical core winter-run population. The PCEs are not important to the Washougal River population, and the PCEs supporting the Lower Gorge population probably were never abundant or extensive due to migration barriers and drainage size. The mainstem Columbia River is a high value connectivity corridor supporting all upstream populations (NMFS 2004).

East Fork Lewis River (HUC5 1708000205) was given a high conservation value as the PCEs support TRT summer- and winter-run populations, and summer-run fish are a TRT genetic legacy population. The PCEs overlap with a FEMAT key watershed for at-risk anadromous salmonids. Improved access above the falls likely makes the PCEs more extensive presently (NMFS 2004, FEMAT 1994).

Headwaters Cowlitz River (HUC5 1708000401), Upper Cowlitz River (HUC5 1708000402), Cowlitz Valley Frontal (HUC5 1708000403), Upper Cispus River (HUC5 1708000404) and Lower Cispus River (HUC5 1708000405) were given high conservation values as the PCEs support winter-run fish via trap and haul. The CHART believed that it was important to emphasize the conservation value of the upper Cowlitz/Cispus HUC5s due to their historic importance and potential to promote conservation of the ESU. The PCEs of the Upper Cowlitz River subwatershed overlap with a FEMAT key watershed for at-risk anadromous salmonids (FEMAT 1994).

Tilton River (HUC5 1708000501) was given a medium conservation value as the PCEs support a TRT winter-run population via trap and haul. The HUC5 is only habitat for a TRT historical winter-run population and other areas in the watershed are likely more important to the DPS (NMFS 2004).

Riffe Reservoir (HUC5 1708000501) was given a high conservation value as the PCEs support two TRT historic winter-run populations via trap and haul. The PCEs are degraded primarily due to inundation. The HUC5 is important as a rearing/migration corridor for upstream populations (NMFS 2004).

North Fork Toutle River (HUC5 1708000504) was given a medium conservation value as the PCEs support a TRT core winter-run population but not as extensive as in the Green River HUC5. The CHART noted recolonization of this area despite volcano-related impacts on the PCEs (NMFS 2004).

Green River (HUC5 1708000505) was given a high conservation value as the PCEs support a TRT core winter-run population more extensively than in other HUC5s supporting this population. The CHART noted recolonization of this area despite volcano-related impacts on the PCEs (NMFS 2004).

South Fork Toutle (HUC 5 1708000506) was given a medium conservation value as the PCEs support a TRT winter-run population (but not a core or genetic legacy population. However, the CHART noted recolonization of this area despite volcano-related impacts on the PCEs (NMFS 2004).

Middle Columbia River steelhead

The critical habitat for Middle Columbia River steelhead was initially designated on February 16, 2000 (65 FR 7764). The initial critical habitat designation consisted of all river reaches accessible to listed steelhead in Columbia River tributaries except the Snake River between Mosier Creek in Oregon and the Yakima River in Washington (inclusive). Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence with the Snake River. Excluded were areas above the Condit and Pelton Dams and areas above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). The final critical habitat was designated 09/02/05 (70 FR 52630). Habitat degradation, including altered hydrology due to water diversions, and impacts form live stock grazing are issues throughout this ESU.

The CHART assessment for this DPS addressed 15 subbasins containing 111 occupied watersheds, as well as the Columbia River rearing/migration corridor. Subbasins were chosen as freshwater critical habitat units because they present a convenient and systematic way to organize the CHART's watershed assessments for this DPS. Of the subbasins in the action area that contain listed fish the CHART determined the following conservation values:

Upper Middle Columbia/Hood (HUC5 1707010501) was given a low conservation value as the tributary PCEs are not associated with a TRT demographically independent population in this region. While the tributary PCEs are of low value, the mainstem Columbia River reaches in the HUC5 have high conservation value for as rearing/migration for all upstream HUC5s and populations (NMFS 2004).

Middle Columbia/ Mill Creek (HUC5 1707010504) was given a high conservation value as the tributary PCS support spawning for one of four TRT demographically independent populations in this region. The Columbia River reaches in the HUC5 contain high value rearing/migration PCEs and support nearly every extant population in this DPS. The CHART noted that the PCEs support winter-run steelhead and these PCEs also overlap with a FEMAT key watershed for at-risk anadromous salmonids (NMFS 2004, FEMAT 1994).

White Salmon River (HUC5 1707010509) was given a medium conservation value as the PCEs are associated with one historic TRT population. The PCEs are limited and the CHART noted that other HUC5s likely have higher conservation value for the DPS in this TRT region (NMFS 2004).

Middle Columbia/Grays Creek (HUC5 1707010601) was given a medium conservation value due to very limited tributary PCEs. The CHART noted that the Klickitat and Deschutes HUC5s likely have higher conservation value for the ESU in this TRT region. The Columbia River reaches have high conservation value a rearing/migration corridor for all upstream HUC5s (NMFS 2004).

Lower Klickitat River (HUC5 1707010604) was given a high conservation value as the PCEs support spawning for one of four TRT demographically independent populations in this region. The CHART noted that the PCEs are in generally good condition throughout this subbasin and this HUC5 likely supports summer- and winter-run steelhead (NMFS 2004).

Upper Columbia River steelhead
The critical habitat for Upper Columbia River steelhead was initially designated on February 16, 2000 (65 FR 7764), but was withdrawn in April 2002. The initial critical habitat designation consisted of all river reaches accessible to listed steelhead in Columbia River tributaries upstream of the Yakima River, Washington, and downstream of Chief Joseph Dam. Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence with the Snake River. Excluded were areas above the Chief Joseph Dam and areas above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). The final critical habitat was designated September 2, 2005 (70 FR 52630).

Construction of the Chief Joseph and Grand Coulee dams caused blockages of substantial habitat, as did that of smaller dams on tributary rivers (NMFS 2000). Habitat issues for this ESU relate mostly to irrigation diversions and hydroelectric dams, altered hydrology, as well as to degraded riparian and instream habitat from urbanization and livestock grazing.

The CHART assessment for this DPS addressed 10 subbasins containing 31 occupied watersheds, as well as the Columbia River rearing/migration corridor. Subbasins were chosen as freshwater critical habitat units because they present a convenient and systematic way to organize the CHART's watershed assessments for this ESU.

Snake River steelhead
The critical habitat for Snake River steelhead was initially designated on February 16, 2000 (65 FR 7764), but was withdrawn in April 2002. The initial designated habitat consisted of all river reaches accessible to listed steelhead in the Snake River and its tributaries in Idaho, Oregon, and Washington. Also included were river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to the confluence with the Snake River. Excluded were areas above the Hells Canyon and Dworshak Dams and areas above longstanding, naturally impassable barriers (i.e., Napias Creek Falls and other natural waterfalls in existence for at least several hundred years). The final critical habitat was designated 09/02/05 (70 FR 52630).

Hydrosystem projects create substantial habitat blockages in this DPS; the major ones are the Hells Canyon Dam complex (mainstem Snake River) and Dworshak Dam (North Fork Clearwater River). Minor blockages are common throughout the region. Steelhead spawning areas have been degraded by overgrazing, as well as by historic gold dredging and sedimentation due to past land management. Habitat in the Snake basin is warmer and drier and often more eroded than elsewhere in the Columbia River basin or in coastal areas.

The CHART assessment for this DPS addressed 25 subbasins containing 271 occupied watersheds and 20 unoccupied watersheds. Subbasins were chosen as freshwater critical habitat units because they present a convenient and systematic way to organize the CHART's watershed assessments for this DPS.

Environmental Baseline

The 'environmental baseline' includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The NMFS describes the environmental baseline in terms very similar terms to those informing the status of the species and critical habitat, with focus specifically limited to the action area defined for the consultation. As such, the environmental baseline focuses the discussion of extant risk factors for the entire species or critical habitat unit to those present in the action area and which might be influenced by the effects of the proposed action.

For actions affecting habitat, NMFS typically describes the environmental baseline in terms of the functional condition of the processes that create and maintain habitat in the action area. Some of the listed species considered in this Opinion are known to spawn, rear, and migrate through freshwater in or through the action area. Thus, for this action area, the relevant habitat conditions are those that support successful completion of those life histories, including:

1. Freshwater spawning sites with water quantity and quality conditions and substrate that supports spawning, incubation and larval development. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.

2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. These features are essential to conservation because without them juvenile salmonid cannot access and use the areas needed to forage, grow, and develop behaviors (*e.g.*, predator avoidance, competition) that help ensure their survival.

3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. These features are essential to conservation because without them juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly,

these features are essential for adults because they allow fish in a non-feeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.

The elements of PCEs that are most relevant to the proposed action are: water quality, substrate, forage, natural cover, and aquatic vegetation as they will be affected by the proposed action. The section that follows describes the existing life history strategies of the fish populations in the action area, and the factors that bear on their present PCEs within each watershed.

Lower Columbia River Chinook in the Action Area
The Columbia River Gorge National Scenic Area and Gifford Pinchot National Forest are located within the Lower Columbia River Chinook ESU in Oregon and Washington. The Lower Columbia River Chinook salmon ESU, listed as threatened on March 24, 1999 (64 FR 14308), includes all natural populations of Chinook salmon spawning below impassable natural barriers from the mouth of the Columbia River to the crest of the Cascade Range, just east of the Hood River in Oregon and the White Salmon River in Washington. This ESU excludes populations above Willamette Falls and in the Clackamas River and Hood River. Recovery planning for Lower Columbia River Chinook recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Willamette-Lower-Columbia/Index.cfm.

Action Area Information. The Lower Cowlitz sub-basin, approximately 15 percent of which is within GPNF, contains more than five miles of anadromous fish habitat. It has one major stream, the North Fork (NF) Toutle River. The NF Toutle River holds roughly 12 miles of anadromous fish habitat inside the GPNF.

The Lower Columbia/Clatskanie sub-basin, less than 5 percent of which is within GPNF, does not have any major streams that contain more than five miles of anadromous fish habitat.

Approximately 10 percent of the Lower Columbia/Sandy sub-basin is within the CRGNSA and another few percent is within GP NF. The majority of streams that contain more than five miles of anadromous fish habitat are on the Oregon side outside the project area.

The Middle Columbia/Hood sub-basin, approximately 35 percent of which is within GPNF and about 5 percent of which is within CRGNSA has four major streams that contain more than five miles of anadromous fish habitat. The major streams are the mainstem of the Columbia River, Wind River, Trout Creek, and Panther Creek. The Wind River contains at least 19 miles of habitat on GPNF land.

The Lewis River sub-basin, approximately 50 percent of which is within GPNF, has 1 major stream, the East Fork Lewis River. The East Fork Lewis River contains roughly miles of anadromous fish habitat within the GPNF.

The LCC ESU has been subject to intensive hatchery influence. Hatchery programs to enhance Chinook salmon fisheries in the lower Columbia River began in the 1870s, releasing billions of fish over time. That equals the total hatchery releases for all other chinook ESUs combined (Myers et al. 1998). Although most of the stocks have come from inside the ESU, more than 200 million fish from outside the ESU have been released since 1930 (Myers et al. 1998). In addition, the exchange of eggs between hatcheries in this ESU has led to the extensive genetic homogenization of hatchery stocks.

Upper Columbia River Spring-Run Chinook in the Action Area
The Upper Columbia River Spring-Run Chinook use the mainstem of the Columbia River for migration. The Upper Columbia River Chinook salmon ESU, listed as endangered on March 24, 1999 (64 FR 14308), includes all natural populations of spring-run Chinook salmon spawning in all accessible river reaches in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Recovery planning for Upper Columbia River chinook is ongoing, and recovery planning status can be reviewed online at:
http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Upper-Columbia/Index.cfm.

Action Area Information. The CRGNSA includes the mainstem of the Columbia River, which provides migratory habitat to Upper Columbia River Spring-Run Chinook.

Snake River spring/summer Chinook salmon in the Action Area

The Snake River spring/summer Chinook salmon ESU uses the mainstem of the Columbia River as migration in order to reach Snake River. The species was listed as threatened on April 22, 1992 (57 FR 14653) and includes all natural-origin populations in the Tucannon, Grande Ronde, Imnaha, and Salmon Rivers. Some or all of the fish returning to several of the hatchery programs are also listed including those returning to the Tucannon River, Imnaha, and Grande Ronde hatcheries, and to the Sawtooth, Pahsimeroi, and McCall hatcheries on the Salmon River. This ESU includes production areas that are characterized by spring-timed returns, summer-timed returns, and combinations from the two adult timing patterns. Runs classified as spring Chinook are counted at Bonneville Dam beginning in early March, ending the first week of June. Runs classified as summer Chinook return to the Columbia River from June through August. Returning fish hold in deep mainstem and tributary pools until late summer, when they emigrate up into tributary areas and spawn. In general, spring type Chinook tend to spawn in higher elevation reaches of major Snake River tributaries in mid-through late August, and summer run Snake River chinook spawn approximately 1 month later than spring-run fish. Recovery planning for Snake River spring/summer chinook is ongoing, and recovery planning status can be reviewed online at:
http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Snake/Index.cfm.

Action Area Information. The CRGNSA includes the mainstem of the Columbia River, which provides migratory habitat to Snake River spring/summer Chinook salmon.

Snake River fall Chinook in the Action Area
The Snake River fall Chinook use the mainstem of the Columbia River as migration in order to reach Snake River. The Snake River fall Chinook salmon ESU, listed as threatened on April 22, 1992, (57 FR 14653), includes all natural populations of fall Chinook salmon in the mainstem Snake River below Hell's Canyon Dam, and the Tucannon, Palouse (to Palouse Falls), Grande Ronde, Imnaha, Salmon, and Clearwater Rivers. Fall Chinook from the Lyons Ferry Hatchery are included in the ESU but are not listed. Recovery planning for Snake River fall chinook is ongoing and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Snake/Index.cfm.

Action Area Information. The CRGNSA includes the mainstem of the Columbia River, which provides migratory habitat to Snake River fall Chinook.

Columbia River Chum in the Action Area
The CRGNSA and GPNF are located within the Columbia River chum ESU in Oregon and Washington. The Columbia River chum ESU, listed as threatened on March 25, 1999 (64 FR 14508), includes all natural-origin populations of chum in lower Columbia River tributaries located downstream from Bonneville Dam on the Columbia River and Merwin Dam on the Lewis River. Historically, chum salmon were abundant in the lower reaches of the Columbia River and extended to the Umatilla/Walla Walla River, but currently are primarily limited to the tributaries downstream of Bonneville Dam. Recovery planning for Columbia River chum salmon is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Willamette-Lower-Columbia/Index.cfm.

Action Area Information. The majority of known natural chum salmon production (less than 1,000 annually) occurs in Grays River, Hamilton Creek (including Hamilton Springs), Duncan Creek, Ives Island complex, St. Cloud area of the Columbia River, and Hardy Creek. Annually, a small number of chum are counted passing Bonneville Dam. Nothing is known about the behavior of these fish. There is incidental spawning of chum in the lower reaches of White Salmon River, and small numbers may be using the mouth of tributaries above Bonneville dam.

The Middle Columbia/Hood sub-basin, approximately 15 percent of which is within CRGNSA, includes Hamilton Creek (including Hamilton Springs), Duncan Creek, Ives Island complex, St. Cloud area of the Columbia River, and Hardy Creek.

The Lower Columbia/Sandy sub-basin, approximately 10 percent of which is within CRGNSA and another few percent of which is within GPNF, does not have any major streams that contain more than five miles of anadromous fish habitat.

Lower Columbia River Coho in the Action Area
Originally part of a larger Lower Columbia River/Southwest Washington ESU, Lower Columbia River coho were identified as a separate ESU and listed as threatened on June 28, 2005. The ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, and includes the Willamette River to Willamette Falls, Oregon, as well as twenty-five propagation programs that were determined not to be divergent relative to the local natural population(s) within the ESU. Recovery planning for Lower Columbia River coho is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Willamette-Lower-Columbia/Index.cfm.

Action Area Information. The Lower Cowlitz sub-basin, approximately 15 percent of which is within GPNF, has 1 major stream, the NF Toutle River, which contains more than five miles of anadromous fish habitat. The NF Toutle River holds roughly 12 miles of anadromous fish habitat inside the GPNF land.

The Lower Columbia/Clatskanie sub-basin, less than 5 percent of which is within GPNF, does not have any major streams that contain more than five miles of anadromous fish habitat.

The Lower Columbia/Sandy sub-basin has approximately 10 percent within CRGNSA and another few percent within GPNF. The majority of streams with habitat are outside the project area on the Oregon side of the Columbia River.

The Middle Columbia/Hood sub-basin, approximately 35 percent of which is within GPNF and another 5 percent of which is within CRGNSA, has the majority of streams on the Oregon side of the Columbia River.

The Lewis sub-basin, approximately 50 percent of which is within GPNF, has 1 major stream. The East Fork Lewis River contains roughly eight miles of anadromous fish habitat inside the GPNF.

Snake River Sockeye in the Action Area
No National Forest in Region Six is contained within the Snake River sockeye ESU, which is located in Southwest Idaho. However, the Snake River Sockeye does use Columbia River and Snake River within Oregon and Washington as a migration corridor to get to and leave from their ESU area in Idaho. The Snake River sockeye salmon ESU was listed as endangered on November 20, 1991, (56 FR 58619) and includes populations of sockeye salmon from the Snake River basin, Idaho (extant populations occur only in the Salmon River subbasin). Under NMFS' interim policy on artificial propagation (58 FR 17573), the progeny of fish from a listed population that are propagated artificially are considered part of the listed species and are protected under ESA. Thus, although not specifically designated in the 1991 listing, Snake River sockeye salmon produced in the captive broodstock program are included in the listed ESU. Recovery

planning for Snake River sockeye is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Snake/Index.cfm.

Action Area Information. The CRGNSA includes the mainstem of the Columbia River, which provides migratory habitat to Snake River sockeye.

Lower Columbia River Steelhead in the Action Area

The CRGNSA and GPNF are located within the Lower Columbia River steelhead distinct population segment (DPS) in Oregon and Washington. The Lower Columbia River steelhead ESU was listed as threatened on March 19, 1998 (63 FR 13347), and reaffirmed as a DPS on January 5, 2006 (71 FR 834). The Lower Columbia River DPS encompasses all steelhead runs in tributaries between and including the Cowlitz and Wind Rivers to the Little White Salmon River on the Washington side of the Columbia River, and the Willamette and Hood Rivers on the Oregon side. Recovery planning for Lower Columbia River steelhead is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Willamette-Lower-Columbia/Index.cfm.

The populations of steelhead that make up the Lower Columbia River DPS are distinguished from adjacent populations by genetic and habitat characteristics. The DPS consists of summer and winter coastal steelhead runs in the tributaries of the Columbia River as it cuts through the Cascades. These populations are genetically distinct from inland populations (east of the Cascades), as well as from steelhead populations in the Upper Willamette River basin and coastal runs north and south of the Columbia River mouth. The following runs are not included in the DPS: the Willamette River above Willamette Falls, the Little and Big White Salmon Rivers, and runs based on four imported hatchery stocks (early-spawning winter Chambers Creek/Lower Columbia River mix, summer run Skamania Hatchery stock, winter Eagle Creek National Fish Hatchery stock, and winter run Clackamas River ODFW stock). This area has at least 36 distinct runs (Busby et al.1996), 20 of which were identified in the initial listing petition. In addition, numerous small tributaries have historical reports of fish, but no current abundance data.

Action Area Information. National Forest lands within the project area are found within two 4th HUC sub-basins identified for this DPS: Lower Cowlitz and and Lewis. This DPS does overlap into other basins found on other National Forest lands outside the project area, such as the Lower Columbia/Hood sub-basin.

The Lower Cowlitz sub-basin, approximately 15 percent of which is within GPNF, has 1 major stream, the NF Toutle River, which holds roughly 12 miles of anadromous fish habitat within the GPNF.

The Lower Columbia/Clatskanie sub-basin, approximately 10 percent of which is within GPNF, does not have any major streams that contain more than five miles of anadromous fish habitat.

The Lower Columbia/Sandy sub-basin, approximately 10 percent of which is within CRGNSA and another few percent of which is within GPNF, contains more than five miles of anadromous fish habitat on the Oregon side outside the project area.

The Middle Columbia/Hood sub-basin, approximately 35 percent of which is within GPNF and another 5 percent of which is within CRGNSA, has 4 major streams that contain more than five miles of anadromous fish habitat inside the GPNF and CRGNSA. The major streams are the mainstem of the Columbia River, Wind River, Trout Creek, and Panther Creek. The Wind River contains at least 19 miles of habitat on GPNF.

The Lewis sub-basin, approximately 50 percent of which is within GPNF, has 1 major stream, the East Fork Lewis River. Within the GPNF, this river holds roughly eight miles of anadromous fish habitat.

Middle Columbia Rive Steelhead in the Action Area
The CRGNSA is located within the Middle Columbia River Steelhead ESU in Oregon and Washington. The Middle Columbia River steelhead ESU was listed as threatened on March 25, 1999 (64 FR 14517) and reaffirmed as a DPS on January 5, 2006 (71 FR 834). The Middle Columbia River DPS encompasses Columbia River basin and tributaries upstream of, and including, the White Salmon River, and exclusive of the Wind River in Washington and the Hood River in Oregon, to and including the Yakima River in Washington. Recovery planning for Middle Columbia River steelhead is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Mid-Columbia/Index.cfm.

Major drainages in this DPS are the Deschutes, John Day, Umatilla, Walla-Walla, Yakima, and Klickitat River systems. Almost all steelhead populations within this DPS are summer-run fish, the exceptions being winter-run components returning to the Klickitat and Fifteen Mile Creek watersheds. A balance between 1- and 2-year-old smolt emigrants characterizes most of the populations within this DPS. Adults return after 1 or 2 years at sea.

Most fish in this DPS smolt at two years and spend one to two years in salt water before re-entering fresh water, where they may remain up to a year before spawning. Age-2-ocean steelhead dominate the summer steelhead run in the Klickitat River, whereas most other rivers with summer steelhead produce about equal numbers of both age-1- and 2-ocean fish. Juvenile life stages (i.e., eggs, alevins, fry, and parr) inhabit freshwater/riverine areas throughout the range of the DPS. Parr usually undergo a smolt transformation as 2-year-olds, at which time they migrate to the ocean. Subadults and adults forage in coastal and offshore waters of the North Pacific prior to returning to spawn in their natal streams. A non-anadromous form of O. mykiss (redband trout) co-occurs with the anadromous form in this DPS, and juvenile life stages of the two forms can be very difficult to differentiate. In addition, hatchery steelhead are also distributed within the range of this DPS.

Recent estimates of the proportion of natural spawners of hatchery origin range from low (Yakima, Walla Walla, and John Day Rivers) to moderate (Umatilla and Deschutes Rivers). Most hatchery production in this DPS is derived primarily from within-basin stocks.

Action Area Information. The CRGNSA is found within Middle Columbia/Hood 4th HUC sub-basin identified for this DPS. This species uses the mainstem of the Columbia River as migration to other 4th HUC subbasins in the Middle Columbia DPS.

Upper Columbia River Steelhead in the Action Area

The mainstem of the Columbia River within boundaries of the CRGNSA is used as a migration corridor by the Upper Columbia River steelhead. The Upper Columbia River steelhead ESU was listed as endangered on August 18, 1997 (62 FR 43937) and reaffirmed as a DPS on January 5, 2006 (71 FR 834). The Upper Columbia River DPS encompasses Columbia River basin and tributaries upstream from and exclusive of the Yakima River in Washington, to the U.S.-Canadian border. Recovery planning for Upper Columbia River steelhead is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Upper-Columbia/Index.cfm.

Action Area Information. The CRGNSA includes the mainstem of the Columbia River, which provides migratory habitat to Upper Columbia River steelhead.

Snake River Steelhead in the Action Area

The DPS includes all naturally spawned anadromous steelhead populations below natural and manmade impassable barriers in streams in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho, as well six artificial propagation programs: the Tucannon River, Dworshak NFH, Lolo Creek, North Fork Clearwater, East Fork Salmon River, and the Little Sheep Creek/Imnaha River Hatchery steelhead hatchery programs. No National Forest in Region Six is contained within the Snake River steelhead DPS, however, the Snake River steelhead do use the Columbia and Snake Rivers within Oregon and Washington as a migration corridor. The Snake River steelhead ESU was listed as threatened on August 18, 1997, (62 FR 43937) and reaffirmed as a DPS on January 5, 2006 (71 FR 834). Recovery planning for Snake River steelhead is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Snake/Index.cfm.

Action Area Information. The CRGNSA includes the mainstem of the Columbia River, which provides migratory habitat to Snake River steelhead.

Environmental and Habitat Conditions in the Action Area

Upper Middle Columbia/Hood (HUC5 1707010501). This subbasin is one of six subbasins located in the Columbia Cascade Province. It encompasses an estimated 1.6

million acres, is bounded in the south at river mile 415.8 by Wanapum Dam near Vantage, WA, and in the north at river mile 545.1 near Bridgeport, WA and Chief Joseph Dam.

Water Quality. While water quality in subbasin is good compared to other rivers in the United States, there is still cause for concern. Primary concerns include levels of dissolved gases, changes in stream temperatures, turbidity levels and exposure to environmental contaminates above biological thresholds for fish species utilizing the river. These concerns are generally related to hydropower production, past mining practices (Canada and Spokane River are or have been major sources above the subbasin planning area), and agriculture. The hydroelectric projects on the Columbia River in the subbasin are "run-of-river" with reservoirs that have little storage capacity. Water velocities are generally fast enough to prevent the formation of a thermocline and the associated depletion of oxygen in deeper waters. Water quality parameters affected by hydropower production include TDG, water temperature, dissolved oxygen (DO), turbidity, suspended sediments and nutrients (Peven 2002).

Middle Columbia/Mill Creek (HUC5 1707010504). This area is a rugged area of limited population referred to as the western highlands. Much of the highland's northern half is owned by the state or by private timber companies and is relatively undeveloped. The southern half is somewhat more open and contains numerous small farms and ranches. Timber production and ranching are the principal economic activities of the area.

The watershed is about 32.5 sq. miles. The headwaters are covered in mixed conifer/oak forest and hay land. Mill Creek is a relatively straight, high energy, and swiftly dropping channel in the lower region. This configuration is typical of the swiftly descending creeks which drain the south portion of the Western Highlands. All of these systems are steeply incised into the basalt layers comprising the Columbia River, yet show few signs of rapid downcutting in the lower, steep sections. Streamside riparian vegetation is fairly dense and water quality appears high.

White Salmon (HUC 1707010509). The White Salmon River originates in the GPNF and flow 45 miles before entering the Bonneville Reservoir. The watershed was traditionally managed for timber and agricultural production; however under the Northwest Forest Plan, much of the drainage has been designated as riparian reserves.

Water Quality. Water quality in the subbasin is good, although the river suffers from yearly high sediment discharges due to glacial-melt in the headwaters. Cascade Creek enters the river at RM 36.9 and is heavily laden with glacial flour. Substantial quantities of sediment are delivered downstream.

Water quality has been monitored since 1992. The dry season is the most critical period for temperature and DO in Pacific Northwest rivers. Measured temperatures within the mainstem during this time period are well within all existing and proposed water quality standards. As is normal, the river generally warms as it moves downstream, however the overall increase is only 39° Fahrenheit (F) to 41°F, in part because the river flows through a deep box canyon (Envirovision 2003). Dissolved oxygen concentrations are excellent throughout the mainstem even during the dry season. There appears to be no consistent trend with distance downstream.

Wind River (HUC5 1707010512). The Wind River drains approximately 225 square miles over a distance of approximately 31 miles. Urban development has been concentrated in two towns located at RM 2 and 7. Anadromous fish species found in the Wind River, below Shipherd Falls are Chinook and coho salmon, and steelhead.

Temperature. The Wind River watershed has been severely impacted by both natural and human caused disturbances. Riparian timber harvest, splash dams, stream clean-outs, and floods have removed stream shade, in-stream large woody debris, and reduced channel stability. The cumulative effects have led to extreme width to depth ratios and bank erosion within Trout Creek, Dry Creek, Middle and Upper Wind River 6th field watersheds. The poor channel conditions (large width/depth low flow ratios) combined with low summer flows and poor stream shade have produced lethal maximum water temperatures for salmonids (greater than or equal to 24° centigrade (C)) within the Trout Creek watershed.

Sediment. Landslides and accelerated bank erosion have altered the sediment budgets of Panther Creek, Trout Creek, Dry Creek, Upper and Middle Wind River 6th field watersheds. The majority of sediment within the alluvial valleys of Trout Creek, Dry Creek, Upper and Middle Wind River watersheds comes directly from bank erosion and within stream sources such as eroding, unconsolidated bank erosion and exposed point gravel bars. This erosion is caused by large woody debris (LWD) removal, lack of vegetative roots and peak flows. Trout Creek, Panther Creek and Lower Wind River 6th field watersheds has the highest turbidity and potential for sediment delivery.

Chemical Concentration/Nutrients. The majority of agriculture within the Wind River has been in the form of timber management. The Wind River Nursery located along Trout Creek, farmed trees for reforestation from the early 1900's to 1997. There has been no known water quality monitoring within the watershed to detect pesticides or herbicides. Underwood Conservation District has evaluated the watershed for nitrate, nitrite, nitrogen, total phosphorus, fecal and total coliform. All tests were barely above detection limits.

Between 2004 and 2005, NMFS completed consultation with the FS on four projects in this HUC. The projects included dam maintenance and operation, dredging, fish passage and trapping, road construction and maintenance, vegetation management, and habitat restoration and improvement. All of the consultations identified some level of incidental take to individual fish. However, none of the actions were likely to jeopardize the continued existence of ESU-listed species nor likely result in the adverse modification or destruction of designated critical habitat.

Lower Klickitat River (HUC5 1707010604). The Klickitat River has its headwaters in the Goat Rocks Wilderness (Tieton Peak. 7,775 ft.) and flows just over 95 miles to the Columbia River at Lyle (RM 180.4), 34 miles upstream of Bonneville Dam. It is one of the longest undammed rivers in the northwest. Major tributaries include Swale Creek, Little Klickitat River, Outlet Creek, Big Muddy Creek, West Fork Klickitat River, and Diamond Fork.

Temperature. The East Prong, West Prong, and mainstem Little Klickitat River; Swale Creek; and Butler Creek, a major tributary the Little Klickitat River, were listed on the 1998 303 (d) list for temperature. Eight reaches on these water bodies violated thermal water quality criteria. Temperatures exceeding state water quality criteria have been recorded in these streams primarily during low flow periods during the summer months; it is presumed that these exceedances are attributable, in part, to lack of stream shading due to degraded or non-existent riparian areas and low summer flows. Additionally, natural water temperatures in some water bodies may exceed state water quality criteria.

Sediment. Mount. Adams has a distinct influence on both water quantity and water quality in the Klickitat River. The primary source of sediment is naturally generated silt from Rusk Glacier on the eastern flank of Mount Adams. The glacier is prone to occasional outburst floods that deliver torrents of water, volcanic debris, and fine sediment via snowmelt to Big Muddy and Little Muddy Creeks, and the West Fork Klickitat. This results in high mainstem suspended sediment during summer months that colors the Klickitat River from the West Fork to the Columbia River 63 miles downstream. Other sources of excess sediment, both natural and anthropogenic, are likely to be miniscule at the watershed scale compared to this source, though they may have adverse effects on fish and fish habitat at the local scale.

Washougal River (HUC5 1708000106). The headwaters of the Washougal River lie primarily in Skamania County. The river flows mostly southwest through Clark County and enters the Columbia River at RM 121, near the town of Camas, Washington. The drainage area is approximately 240 square miles. Most of the basin is forested and managed for timber production. Of the basin's land area, 61 percent is privately owned and most of the remainder is State Forest land. A small portion of the upper basin lies within the GPNF, comprising approximately 8 percent of the total basin area.

Water Quality and Temperature. Water quality concerns in the basin include temperature, pH, fecal coliform, and DO. Lacamas Creek and several tributaries were listed on the 1998 state 303(d) list for exceedances of water quality standards (WDOE 1996). Lacamas Creek below Round Lake has elevated DO and temperature. In the 1970s, Lacamas Lake was identified as having eutrophication problems due to phosphorous loading. High water temperatures have been measured in several upper basin tributaries between 1997 and 1999. Exposed bedrock, low flows, poor riparian canopy cover, and livestock watering detention systems are suspected of contributing to elevated water temperatures. Though only limited data exists, water temperatures in the lower river are also believed to be high.

Sediment. Elevated turbidity is seen as a potential problem in the Little Washougal, Jones, and Dougan Creeks. Historically, discharges from the paper mill created water quality problems in the Camas Slough. Wastewater is now treated at facilities on Lady's Island though pollutants that have accumulated in sediments could still be a problem.

There is also a concern about the Skamania and Washougal Salmon Hatcheries' release of potentially harmful effluent containing antibiotics and diseases.

Nutrient levels are believed to be limited due to the lack of salmon carcasses as a result of low escapement levels for most species.

Columbia Gorge Tributaries (HUC5 1708000107). This watershed is located in the Southwest Washington province. It ranges from Lawton Creek, on the west, to the "Lakes"area near Bridge of the Gods, to the east. It is bordered by state and private lands to the north, and the Columbia River to the south. The entire area is located in Skamania County. The total watershed is 43,554 acres. About 85 percent (36.886 acres) is within and 15 percent (6, 668 acres) is outside of the CRGNSA.

Temperature. Very little water quality data have been found for any of the streams in this watershed. This is in large part because these streams are primarily on lands that have been under private or state ownership, and there has been no concerted effort to monitor or assess water quality conditions. More recently, stream surveyors from the FS have collected grab samples of water temperature. Because most of the streams in the watershed have a north south orientation, steeply incised drainages, and relatively dense vegetation along many of the mainstem reaches, risk of water temperature increases is relatively low. However, because these streams have a high degree of variability between their headwaters and mouths, there are places within each stream where the risk for temperature increases is greater.

Hamilton Creek is the stream with the greatest potential for increased water temperatures. This stream is larger than most of the others, it has more stream miles at lower gradients than the others, flows through a broader valley, and flows through a relatively well developed area near its mouth. The lower reaches are in many cases lacking in adequate vegetative canopy cover to protect against temperature increases. Lawton Creek may have the lowest potential for increased water temperatures throughout most of its length because this relatively short stream is very steeply incised and densely vegetated along the mainstems of both major forks.

Sediment. There has been no known water quality monitoring for turbidity in the watershed. Based on the relatively high gradients of most stream reaches in the watershed, it is likely that increases in turbidity are relatively short-lived in these streams, and coincide closely with the timing of inputs of sediment. Sediment sources are numerous. Mass wasting is not a frequent supplier of sediment to these streams, but surface erosion from developed areas including roads, residential, agricultural and other land uses is the dominant source.

Hardy Creek, one of the smallest subwatersheds with some of the most consistently steep slopes, has the highest road crossing density and one of the highest number of miles of road on steep slopes. This subwatershed may be at the greatest risk for increases in turbidity from road sources. In contrast, Indian Mary Creek, the smallest subwatershed in the watershed, has fewer road crossings, a low road crossing density, and the lowest number of miles of road on steep slopes. It is important to point out that roads are only one source of sediment, and other kinds of land contribute sediment to streams.

East Fork Lewis (HUC5 1708000205). There are a total of 288 stream miles in the upper East Fork Lewis River watershed, including all Forest Service System Lands within the five sixth-field sub-watersheds. Three sub-watersheds contain most of the National Forest System Lands that drain into the East Fork Lewis River Watershed: the East Fork Lewis River Headwaters, the Upper East Fork Lewis River, and Copper Creek.

The Northwest Forest Plan designated the Upper East Fork Lewis River Watershed as a Key Watershed. Key Watersheds were selected for their direct contribution to anadromous salmonid and bull trout stocks. They serve as refugia for maintaining and recovering habitat for at-risk stocks of anadromous and resident fish species. The two primary beneficial uses within the Upper East Fork Lewis River Watershed are fish habitat and domestic water supply.

Temperature. High water temperatures during summer months represent the most important water quality concern in the upper East Fork Lewis River. The East Fork Lewis River is listed at two locations downstream in the Washington 1998 section 303(d) list (WAC 173-201-080). The mainstem of the East Fork Lewis River has the highest stream temperatures of all major streams in the Upper East Fork Lewis River Watershed, within the GPNF boundary. The maximum 7-day average temperature was 18.0° C in 2001 in the mainstem of the East Fork, downstream of Sunset Falls Campground near GPNF boundary. River temperatures downstream of Slide Creek exceeded 16°C for extended periods in 2001. Historical data are limited in the Upper East Fork Lewis River Watershed.

Sediment. The Pacific Watershed Institute conducted a sediment budget and landslide analysis in the East Fork Lewis River watershed during 1998. The Upper East Fork Lewis River Watershed is considered to be sediment supply-limited due to various factors including depletion of sediment sources due to fire and subsequent salvage-related landslides, naturally thin soils, recent low landslide rates, and the observation that gravels are not plentiful naturally.

Of the various surface erosional processes at work in the watershed, sediment delivery via roads is the most prevalent. Principal mechanisms for sediment delivery to streams from roads in the East Fork Lewis River Watershed were identified: surface ravel from exposed cut-and fill-slopes, sidecast and fillslope failures, and undermining of roadbeds due to gully erosion associated with insufficient drainage. Unlike the composition of landslide sediments, finer materials including sand and silts are believed to dominate the largest fraction of sediments delivered via roads to stream channels. Most fines are transported along road surfaces during high intensity and/or long duration storms when water is conveyed to streams along road treads. Because the Upper East Fork Lewis River and its tributaries are transport reaches, most sediment from National Forest System Lands are transported downstream, off-forest.

Road density, stream crossings, stream channel network increase are used to indicate potential for road derived sedimentation. Another effect of roads in the East Fork is to block downstream passage of desirable sediment and organic matter. This effect has not been quantified, but has been observed in the watershed.

While the Upper East Fork Lewis River Watershed is considered sediment-supply limited, factors contributing to this condition include blockage of sediment delivery by undersized or lack of culverts, and the lack of large wood within the watershed that would function to retain sediment within stream channels. Additionally, the aging nature of the road system in the drainage, the absence of adequate drainage on unmaintained roads, the high road density within riparian reserves and the high number of stream crossings increases the potential risk of delivery of finer sediments to streams.
Turbidity from sediment delivery via roads has not been measured in the watershed. Some riparian road systems do contribute sediment to the East Fork Lewis River and its tributaries. Spring road maintenance (including blading) along the 42 Road is only permitted after July 1 due to observed turbidity in the East Fork Lewis River, which occurred during a rainstorm that immediately followed surface blading activities. Turbid water has also been observed entering Copper Creek near the 4109 Road, flowing directly from a small channel linking the muddy road surface to the stream.

Chemical Contamination/Nutrients. An analysis of the chemical constituents within waters of the East Fork Lewis River Watershed has not been performed. However, chemical water pollution is not likely. It is likely that the waters in the Upper East Fork Lewis River are actually *nutrient limited* based on the lack of instream wood or low frequency of holding pools that would allow the accumulation of organic material that would contribute to the productivity of the system. A resource concern in the Copper Creek drainage includes an abandoned system of copper mines near the Miner's Creek and Copper Creek confluence. Several spur roads (4107 system) lead to and radiate from the abandoned site, and lie entirely within riparian reserves.

In 2004 and 2007, NMFS completed consultation on two projects in this watershed. In 2004, NMFS consulted with itself on the Storedahl Gravel Pit Daybreak Mine Expansion and Habitat Enhancement project. In 2007, NMFS consulted with the U.S. Department of Transportation on a bridge construction and repair project. In both cases, NMFS identified some level of incidental take to individual fish. However, none of the actions were likely to jeopardize the continued existence of ESU-listed species nor likely result in the adverse modification or destruction of designated critical habitat.

Headwaters Cowlitz River (HUC5 1708000401). The Headwaters Cowlitz River watershed is a 216.3 square mile drainage area between the Muddy Fork of the Cowlitz River and headwaters of the Clearfork Cowlitz River. The Clearfork Cowlitz watershed includes four 6th field sub-watersheds; Ohanapecosh, Summit, Clearfork Cowlitz, and Muddy Fork Cowlitz river. Anadromous fish species found in Headwaters Cowlitz are Chinook and coho salmon, and steelhead.

Temperature. There are very little water temperature data for this watershed. The few existing data show cold water temperatures. Given the position in the watershed, altitude, relatively unmanaged condition of the watersheds and glacial source of these streams it is unlikely that water temperatures exceed 14° C.

Sediment/Turbidity. Many of the streams were rated for fine sediments under the Clear Fork watershed analysis in 1998. None of the streams were rated as being 100 percent good. Best habitat conditions were in the Ohanapecosh River (96 percent good) and (Clear Fork Cowlitz River 68 percent Good), Summit Creek (100 percent Good where data existed). The worst areas were Lava Creek (100 percent Poor), Little Lava Creek (100 percent Poor), and Cortright Creek (50 percent Poor).

Chemical Concentration/Nutrients. On April 25, 2002 a small oil spill was detected at Jody's bridge. The source of this pollution was undetermined until April 29, 2002.

Upper Cowlitz River (HUC5 1708000402). The Upper Cowlitz River watershed is located in the GPNF of southwest Washington. The watershed is defined as the 167 square mile drainage area between Johnson Creek in the west and Coal Creek in the east. The current delineation of the Upper Cowlitz River watershed includes only a portion of the former Upper Cowlitz River watershed. The re-delineation of the watershed boundaries occurred in December 2000. The Upper Cowlitz River watershed includes six 6^{th} field sub-watersheds. ESA listed anadromous fish that occur in the Upper Cowlitz River watershed are Chinook and coho salmon, and steelhead.

Temperature. Water temperatures in most of tributaries managed by the GPNF meet the 14°C, however, water temperatures in a couple of the key tributaries Skate Creek and Lake Creek are slightly higher. While there are no data for the Cowlitz River itself, because of its width and exposure to sunlight it is most likely warmer than 13 °C. Because this watershed is just down stream from the glacially fed Muddy Fork of the Cowlitz River, it is unlikely that water temperatures exceed 14°C.

Sediment. There are no data to address the condition of spawning gravels directly. Road failures, landslides, and avalanche chutes are contributing sediment to some streams. In addition, spawning areas of some streams have elevated levels of fine-grained sediment.

Chemical Concentration/Nutrients. The town of Packwood, which is located in the middle of the watershed, contains septic tanks and lawns that are located near the Cowlitz River. With the exception of stream temperature, there are no water quality data for streams in the watershed. A fuel oil spill originating a storage tank outside of the watershed, enterd the watershed on or about April 26, 2002. In addition, this spill points out the potential for such spills to occur in a developed setting.

Cowlitz Valley Frontal (HUC5 1708000403). The Cowlitz Valley Frontal is a 207 square mile drainage area between Smith Creek and the confluence with the Cispus River. The watershed includes a portion of the former Upper Cowlitz watershed and all of former Middle

Cowlitz River watershed. The Cowlitz Valley Frontal watershed includes eight 6th field sub-watersheds.

Temperature. A number of streams in the watershed have exceeded the Washington State Water Quality standard of 16.0° C in the summer of more than one year: Oliver Creek, Peters Creek, Lake Creek, North Fork Martin Creek, Lynx Creek, Silver Creek, and Kiona Creek. Willamette Creek. is currently on the 303 (d) list for temperature.

Sediment/Turbidity. A number of streams have segments with gravel deposits that are filled in with fine-grained sediment (and therefore their gravel deposits were rated as "poor"): Kiona Creek, Peters Creek, Miller Creek, Lake Creek, Lynx Creek, Silver Creek, Siler Creek., Squire Creek, Schooley Creek, and Davis Creek.

Chemical Concentration/Nutrients. There are no known water quality problems outside of stream temperature; however, the potential exists for chemical/nutrient contamination of streams because of the presence of development along the Cowlitz River. Development in the floodplain of the Cowlitz River includes the town of Randle, ranches, and lumber mills.

Upper Cispus River (HUC5 1708000404). The Upper Cispus River watershed is located in the GPNF of southwest Washington. The watershed is defined as the 242.5 square mile drainage area downstream from the confluence of the Cispus River and North Fork Cispus River and includes all of the tributaries to the Cispus River in that area. Upper Cispus River watershed includes nine 6th field sub-watersheds. The conditions of all 9 sub-watersheds were rated in the Upper Cispus Watershed Analysis. ESA listed anadromous fish that occur in the Upper Cispus River watershed are Chinook and coho salmon, and steelhead.

Temperature. The water temperature is not severe for salmonids only because they are adapted to warmer water temperatures. Water in the Adams Fork and Muddy Fork may be slightly cold for these species and inhibit their ability to feed due to glaciers or ground water feeding the streams.

Sediment. The Middle and Upper Cispus Watershed Analysis 1995 reported that fine sediments impaired spawning habitats in the Cispus and North Fork Cispus rivers. This report is consistent with observations on these streams. Fine-grained sediment in the Muddy Fork is largely derived from the glacial flour and represents the potential for this system. Likewise, the sediments observed in Walupt Creek originate in the wilderness and represent the natural potential. The level of forest harvest activity in the Chambers Creek drainage is likely to have increased fine sediment levels. Sediments in Adams Fork are also likely derived from glaciers, but the sediments in Sheep Creek portion are more likely to be derived from a combination of management actions (the 5601 road and older timber harvest units).

Chemical Concentration/Nutrients. There are no 303(d) listed water bodies in the watershed listed for parameters other than temperature. The potential sources of pollution in the watershed are limited to campgrounds, dispersed sites, and occasional spills from automobile or heavy machinery accidents. The presence of out houses and manure control measures at all of the developed campsites, substantiates the relatively low levels of pollution observed at dispersed sites.

Lower Cispus River (HUC5 1708000405). The Lower Cispus watershed encompasses about 123,500 acres in the Cispus River drainage of the GPNF. Most of the watershed is National Forest land, with some private land inclusions also. The northern portion of the watershed is bounded by the ridges forming the boundary between the Cispus and Cowlitz River watersheds while the southern boundary is defined by the break between the Cispus and Lewis River watersheds. To the east is the boundary between the Lower Cispus and Upper Cispus watersheds (primarily Juniper Ridge). To the west is the boundary between the Lower Cispus and Lower Cowlitz watersheds (primarily the ridge that runs between Goat Mountain and Tumwater Mountain). There are eight subwatersheds and associated aquatic features within the Lower Cispus watershed. ESA listed anadromous fish that occur in the Lower Cispus River watershed are Chinook and coho salmon, and steelhead.

Temperature. The natural range of summer maximum stream temperatures in the Lower Cispus watershed is estimated to range from 11.0 to 19.0 °C. The temperatures of all streams monitored to date have fallen within this range with the exception of three streams; Cispus River (at river mile 6.5), Greenhorn Creek and 1918 Creek. Stream temperatures exceed 16.0 °C throughout the Lower Cispus River watershed. Previous management activities such as riparian harvest and removal of large wood from streams probably resulted in increases to the temperatures of some of the streams within the Lower Cispus River watershed, although to what degree is uncertain.

Several of the major tributaries (Yellowjacket Creek, Iron Creek, Greenhorn Creek, Woods Creek, and the lower portion of the Cispus River) regularly exceed 16°C during the summer rearing period. Of the streams listed only the Cispus River and Yellowjacket Creek contain the typical spawning habitats of Chinook salmon. Both of these streams have cooler water upstream refuges.

Sediment/Turbidity. Sediment delivery from roads and management-related landslides has changed the natural sediment regime by increasing the amount of sediment that streams must process. Roads with sediment delivery of 20 tons or greater per mile were designated as "high risk" in the GPNF Roads Analysis. Landslides were reviewed and designated based on proximity to roads or harvest units, through either and professional judgment by a geologist/soil scientist. The three subwatersheds where the most sediment delivery from roads occurred are Iron Creek, Cispus River-Camp Creek, and Lower Cispus River Frontal. The three subwatersheds with the most acres of management related landslides are Yellowjacket Creek, Quartz Creek, and Iron Creek.

Chemical Contaminants/Nutrients. There are no data with which to address this indicator. Previous watershed analyses indicated concerns in only two streams, Red Springs Creek (a tributary to Quartz Creek) and Camp Creek (a tributary to McCoy Creek). The problems appear to be isolated in these particular streams. There are many residences, a couple of ranches in watershed but no towns, mills, or factories.

Tilton River Watershed (HUC# 1708000501) and Riffe Reservoir (HUC5 1708000502). The Lower Cowlitz watershed is located in southwest Washington and contained in Cowlitz, Lewis, and Skamania counties. The Riffe Reservoir is one of the subbasins within the Upper Cowlitz watershed. Occupied watersheds encompass approximately 1,460 square miles and 1,510 miles of streams.

Fish distribution and habitat use data identify approximately 350 miles of occupied riverine habitat in the watersheds (WDFW 2003). Habitat in two watersheds – Tilton River and Riffe Reservoir – is located upstream of impassable dams (Mayfield and Mossyrock) and only accessible to anadromous fish via trap and haul operations.

North Fork Toutle River (HUC5 1708000504), Green River (HUC5 1708000505), and South Fork Toutle River (HUC5 1708000506). The Toutle River basin comprises approximately 513 square miles, primarily in Cowlitz County with some tributaries in Lewis and Skamania counties. The Toutle River enters the Cowlitz River approximately five miles upstream of the town of Castle Rock, Washington. Principal tributaries include the Green River and, South Fork and North Fork Toutle.

Forestry is the dominant land use and commercial forestland makes up over 90 percent of the basin. Much of the upper basin around Mount St. Helens is within the Mount St. Helens National Volcanic Monument and is managed by the U.S. Forest Service. A significant proportion of the forests to the north and west of Mount St. Helens were decimated in the 1980 eruption. Intensive forest harvest and road building followed the eruption and contributed to widespread sediment and flow impairment. The majority of the forest is now in early seral or 'other forest' (bare soil, shrubs) vegetation conditions.

Of the three primary tributaries (North Fork, South Fork, Green River), the North Fork Toutle suffered the greatest eruption-related impacts, followed by the South Fork and then the Green River, which was mostly spared the devastating mud and debris flows. The sediment loads in the North Fork remain very high, with a braided channel that is under frequent adjustment. The North Fork is further impacted by the Sediment Retention Structure that was created in an effort to retain sediments following the eruption, but has become a persistent source of sediment to downstream reaches. The South Fork, which also continues to suffer from high sediment loads, is recovering more rapidly than the North Fork. Portions of all three subbasins suffer from altered stream temperature regimes.

<u>Effects of the Action</u>

"Effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, which will be added to the environmental baseline (50 CFR 402.02). Neither the GPNF CRGNSA nor NMFS identified any interrelated or interdependent actions during consultation.

During consultation, the agencies focused on two categories of effects to which fish would be exposed. The first category stems from activities that modify habitat in a way that fish would experience and respond to by changing their normal behavior. The second category consists of physical interaction between GPNF and CRGNSA workers carrying-out invasive plant treatments and salmon, steelhead, or incubating redds. The latter category includes the possible trampling of fish or redds that could injure or kill fish, or disrupt (or end) incubation. After consultation, NMFS believes the number of incidents would be so low given the program's scope and timing restrictions, and PDCs, that it could not adequately predict such occurrences. The GPNF and CRGNSA disagreed asserting that the possibility of trampling exists. Therefore, NMFS analyzed the effects of trampling below. Nevertheless, NMFS cannot relate these effects to predictable amount of injured or dead fish and as such, trampling is not considered in the Incidental Take Statement that accompanies this Opinion.

The habitat modification analysis in this Opinion focuses on those activities of invasive plant treatment that will change the environment in a way that some life history will encounter, resulting in a change of normal behavior. These activities include physical (manual or mechanical), biological controls, and chemical treatment of both known site-specific infestations, and future EDRR program infestations that are presently unknown or non-existent but would be discovered in the next five to 15 years. For the chemical treatments, the description breaks out the results of treatments in and around running streams, riparian areas, and those in and around dry intermittent channels and ditches. The basis for the breakout is explained below.

For the known site-specific infestations and the EDRR program invasive plant treatments, chemical treatments are central to the analysis. The use of chemical treatment is likely to directly affect fish, and indirectly affect their food. The effects range from killing fish outright as a result of subtle, sublethal changes in behavior or physiology, to reductions in the availability of prey (Scholz et al. 2005). The analysis is based primarily on toxic effects of herbicides (including surfactants, adjuvants, dyes, and other additives to chemical formulations) on listed fish and their prey, and secondarily on the physical effects of invasive plant treatment, including the non-chemical treatment effects. Non-chemical treatment effects include the physical effects of weed removal, such as sediment-filtering during construction, and the minimal extent of riparian function that weeds might provide such as shade, cover, and loss of debris recruitment.

Most of the adverse effects from the proposed action are short-term in nature and are caused by invasive plant treatments in or adjacent to the stream. NMFS has evaluated the effects of treatment adjacent to streams in many individual consultations over the past ten years. The knowledge gained from these individual consultations has been applied by NMFS and the FS to compose the project PDCs for this consultation. Invasive plant treatment activities that introduced the greatest risk to listed fish (*i.e.,* aerial application, prescribed burning) were not included.

Implementation of a successful integrated weed management (IWM) plan for invasive plants on the GPNF and CRGNSA should have long-term beneficial effects on listed fishes and their designated critical habitat by removing invasive plants detrimental to channel forming processes and subsequently to spawning and rearing habitat, and by restoring native riparian vegetation, and thereby, restoring ecosystem and riparian functions. Potential adverse effects should be short-term, and if, as expected, invasive plant treatments are successful, should be offset by long-term benefits to riparian function, surface erosion, prey species production and possibly other habitat features (NMFS 2005b). For example, if monocultures of invasive plant species are eliminated that exclude native trees and other woody plants from the riparian zone, shade and large woody debris recruitment should increase over time, while bank erosion should decline. The time lag in such situations may be several decades, however, before native riparian tree species function properly in the aquatic ecosystem.

Most short-term adverse effects of the proposed activities will result from near-stream and below bankfull emergent invasive plant treatment. The first step of the analysis estimates the likelihood invasive plant treatments will expose listed fish to adverse effects. The second step assesses the responses of exposed individual fish, and in turn, the populations and ESU or DPS they are part of. Risks are considered in terms of the characteristics of viable salmonids populations (McElhany et al, 2000). Finally, risks from invasive plant treatments, expressed as exposure and effect predictions, are also evaluated for critical habitat.

Effects on Endangered Species Act-Listed Species

The analysis of the effects of herbicides on salmonids is evaluated in this Opinion by assessing the likelihood that listed fish and other aquatic organisms or plants that contribute to their nutrition will be exposed to the herbicides. The toxicological effects and ecological risks of the chemicals on listed fish and other aquatic organisms are quantitatively and qualitatively assessed based on the exposure risk and toxicity. The analysis considers: (1) The life history stages (and any associated vulnerabilities) of the listed species present in the action area; (2) the routes of exposure and the associated modeled and calculated exposure levels; (3) the known or suspected mechanisms of toxicity for the active ingredients or known adjuvants; (4) PDCs, chemical application rates, location, application methods, and other factors that determine the likelihood of chemicals reaching the water; and (5) the possibility of additive or synergistic interactions with other chemicals that may enter surface waters as a result of mixtures, be they tank mixtures or in-situ mixing between upstream and downstream emergent treatment or run-off.

In contrast to the effects of exposure to chemicals, adverse changes in terrestrial vegetation from the both physical and chemical treatment will be small because of the spatial and temporal limitations on management under treatment of known and future EDRR program sites. In turn, the longer term result of controlling invasive plants in the treated areas will enable beneficial succession by native vegetation that better matches the natural ecology in treated areas.

Exposure: Presence of the Listed Species in the Action Area. The GPNF and CRGNSA-administered lands in watersheds with listed salmon contain over 6,300 miles of streams on the GPNF and approximately 189 miles of streams on the CRGNSA. Of that distance, only 66 stream miles on the GPNF and 3.4 stream miles on the CRGNSA fall within the identified treatment areas. The three listed species, LCC, LCRC, and LCS range variably throughout the GPNF. The five listed species LCC, LCRC, LCS, MCS, and CC range variably throughout the CRGNSA. The remainder of the listed species covered in this Opinion pass by the CRGNSA during migration, and can be found, as juveniles, utilizing the nearshore areas. Of all the listed species that utilize streams on the GPNF and CRGNSA, the LCS ranges the most broadly of the five most widely ranging listed species. In addition, because of its life history strategy it is found in the rivers year-round. Thus, it was used as the most conservative indicator for potential exposure.

Total road miles and total stream crossings within treatment areas provide estimates of potential exposure to listed fish from herbicide applications. Stream crossings and storm runoff from roadside treatments are vehicles for herbicide exposure. Appendix Tables B3 and B9, below, illustrate that certain watersheds contain greater or lesser road miles and stream crossings than others.

Of the total GPNF road miles within the treatment areas with listed fish, the Upper Cowlitz River watershed has the greatest number (148.15 road miles), followed by the Upper Cispus River watershed (116.91 road miles). However, the length of treatment acre road miles located within a 50 meter riparian buffer of mapped LCS streams shows that the East Fork Lewis River has the greatest with 4.94 road miles, and the Lower Cispus River watershed has the next greatest with 1.21 road miles. The number of stream crossings directly over LCS mapped streams within treatment areas does not follow a similar pattern. The Lower Cispus River watershed has the greatest number road crossing located directly over LCS streams (7), while the East Fork Lewis River watershed has the next greatest (6). In contrast, the Upper Cowlitz River watershed and the Upper Cispus River watershed have the greatest total stream crossings located in treatment areas (381 and 321, respectively). Thus the potential for herbicide exposure from road treatments appears to be greatest in the East Fork Lewis, Upper Cowlitz, Upper Cispus and Lower Cispus River watersheds. Other watersheds such as the Wind River and Clearfork Cowlitz River also have some potential for herbicide exposure from road treatments (Table B3).

Of the total CRGNSA road miles within the treatment areas with listed fish, the Middle Columbia/Grays Creek has the greatest number (three road miles), followed by the Lower Klickitat River watershed (two road miles) (Table B9). The length of treatment acre road mile located within a 50 meter riparian buffer of mapped steelhead (LCS or MCS) stream shows that the Columbia Gorge Tributaries have the greatest with a nominal 0.22 road miles. The Lower Klickitat River watershed has the greatest number of total stream crossings located in treatment areas, as well as the greatest number of total stream crossings within 660 feet of steelhead streams in the treatment areas (20 in both cases) (Table B9). Thus the Lower Klickitat River watershed has the greatest potential for herbicide exposure from road treatments.

In a prior consultation, NMFS conducted an analysis to distinguish between treatment regimes that were and were not likely to adversely affect listed species and designated critical habitat. If herbicides are applied within an entire 660 feet of a ditch line that discharges to a stream, the concentration of herbicides can increase prior to discharge (Huang et al. 2004). The NMFS analysis determined that treatment of invasive plants within ditches and dry channels closer than 660 feet to a confluence of a stream and which were to be treated along the entire length of the ditch or dry channel minus the appropriate buffer to a confluence with a fish bearing water were likely to adversely affect listed fish and designated critical habitat. Tables B3 and B9 in the Appendix below identify the number of stream crossings by watershed that are closer than 660 feet to the confluence of LCS or MCS mapped streams. The three watersheds on the GPNF with the greatest number of stream crossings within 660 feet of a confluence with a LCS bearing water are the Upper Cispus River watershed (30) and Lower Cispus River and East Fork Lewis River watersheds (29 each). On the CRGNSA, the Lower Klickitat River watershed has, by far, the greatest number of stream crossings within 660 feet of a confluence with an MCS bearing water (Table B9).

Exposure Mechanisms: Accidental Wounding or Killing by Trampling. The GPNF and CRGNSA identified the possibility of people working in water stepping on redds and disturbing spawning fish. The extent of exposure depends on the species present, life stage, number of people in the water, and the amount of time spent in the water. Exposure of redds or spawning fish to trampling is possible unless work in water is limited in timing and duration. The proposed action minimizes exposure by planning and scheduling activities to avoid disturbance of spawning fish or damage to redds. Exposure of fry and smaller rearing juveniles has the potential to occur as they only move short distances to the closest cover. Exposure of larger juveniles and adults is unlikely to occur as they generally avoid predators and are likely to swim away when people are in the water. These facts apply for activities conducted under both known treatment sites and to EDRR program activities. Therefore, trampling is unlikely and adverse effects from trampling are discountable.

Exposure Mechanisms: Habitat Modification. As described above, the activities most likely to expose fish to habitat modification are the physical (manual and mechanical) treatment of invasive plants, and the chemical treatment of invasive plants and the areas containing them. Each mechanism of exposure is described below.

Cultural Grazing with Goats. Livestock grazing, in this case goats, would be conducted to reduce invasive plant populations. Goats prefer broadleaf herbs. They can control woody species by standing on their hind legs and can browse on vegetation that other animals can not reach. Grazing would cause short-term disturbance similar to mechanical methods, resulting in more bare ground and decreased cover for listed species. Fertilization may increase competitive advantages of native plants and improve forage quality and quantity, contributing to improved fish habitat. However, in naturally nutrient-poor soils, fertilization may give the competitive advantage to invasive species, which would further perpetuate habitat degradation. Off-site movement of fertilizer can have substantial adverse effects to aquatic habitat and may have toxic effects as well.

Manual, Mechanical, and Restoration Treatment Activities. Mechanical treatments can include use of brush cutters (or other machinery) with various types of blades to remove plants, see Appendix A of the 2006 GPNF and CRGNSA DEIS. Manual methods include the use of hand-operated tools (e.g., axes, brush hooks, hoes, shovels, hand clippers) to dig up and remove invasive species (USDA 2005a). All physical treatments can cause or lead to decreased riparian vegetation (albeit, undesirable vegetation), and in turn to erosion, turbid water, stream sedimentation, and disturbance of aquatic organisms if carried out over a large enough area. Riparian vegetation affects habitat in several important ways. Roots of riparian vegetation reduce soil erosion, stabilize banks, and help to create overhanging banks, with the cumulative effect of minimizing turbidity and instream fine sediment deposition. Riparian and emergent aquatic vegetation can provide hiding cover or refuge for fish and other aquatic organisms where native plants have been replaced. Finally, riparian vegetation can provide some shade function, helping to maintain water temperature by limiting exposure to the sun.

Persistence of increased turbidity depends on the size of the suspended particle and velocity of the water. Exposure to fine sediment depends on the amount of fine sediment introduced and the holding capacity of the surface water. Increased turbidity can reduce feeding ability or gill function in some fish species and fine sediments can cover eggs or spawning gravels. Exposure of listed aquatic species will vary with the proximity of the species and their habitat to the treatment area and the size of the area treated. Riparian surface soils in the GPNF and CRGNSA vary from ash soils with high permeability to clay soils with lower permeability.

Sediment in suspension can harm fish gills, and interrupt feeding and migration. Sedimentation can cover eggs or spawning gravels, reduce prey availability, fill pools, and change width/depth ratios. Soil can also become compacted and prevent the establishment of native vegetative cover. All invasive plant treatments can reduce insect biomass, which would result in a decrease in the supply of food for fish and other aquatic organisms.

Aquatic species have specific needs in terms of water temperature. Increasing water temperature may decrease the dissolved oxygen in water which may affect metabolism and food requirements. Many factors influence water temperature including shade, stormwater discharge, channel morphology, air temperature, topography, stream aspect, and interactions with ground water. Shade is the factor that has the potential to be impacted by any treatment that removes vegetation, but only where that is the only factor affecting water temperature. In addition, a significant amount of vegetation would need to be removed to change water temperature in the stream.

Treatment acres within 50 meters of an LCS or MCS occupied stream can be used as a metric to predict water temperature effects from manual or mechanical vegetation removal. Appendix B, Tables B4 and B10, provides the comparison between the total treatment acres within each 5^{th} field watershed and the treatment acres located within

50 meters of LCS and MCS occupied streams. Across the entire GPNF managed landscape, over 10,000 gross treatment acres have been identified. Of those identified gross treatment acres only 2,772 treatment acres are located within 50 meters of any stream. And of those treatment acres within 50 meters of any stream, only 256 treatment acres are located within 50 meters of LCS streams. Across the entire forest, this equates to only 2.5 percent of treatments that could affect water temperature as a result of vegetation removal (Table B4). The limited amount of treatment acreage within 50 meters of LCS streams is spread across numerous watersheds and is patchy in nature. Therefore, vegetation removal is not likely to increase water temperatures.

As above, vegetation removal is unlikely to affect water temperature. Across the entire CRGNSA managed landscape, over 1,100 gross treatment acres have been identified. Of those identified gross treatment acres only 170 treatment acres are located within 50 meters of any stream. And of those treatment acres within 50 meters of any stream, only 66 treatment acres are located within 50 meters of LCS streams. Across the entire scenic area, this equates to approximately 6 percent of treatments that could affect water temperature as a result of vegetation removal (Table B10). The limited amount of treatment acreage within 50 meters of LCS or MCS streams is spread across numerous watersheds and is patchy in nature. Therefore, vegetation removal is not likely to expose listed fish to measurably increased water temperatures.

Exposure Mechanisms: Herbicide Applications and Estimated Exposure Levels. During consultation, NMFS identified three scenarios creating the chance of herbicide exposure for listed fish. These include 1) runoff from riparian application, 2) application within perennial streams, and 3) runoff from treated ditches and dry intermittent streams. Each exposure scenario was analyzed to determine the level of acute exposure risk. The risk of chronic exposure from riparian application of the ten herbicides included in the activity description was analyzed for the USFS R6 2005 BA and that analysis is incorporated by reference and summarized below.

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 test durations (90 days for fish, 21 days for aquatic invertebrates). The analysis also concluded that chronic effects on algae (21 days) from herbicides other than sulfometuron are not possible from activity. Chronic effects on 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 on 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 active ingredient (a.i)./acre is the typical rate, and 0.25 pounds a.i./acre is the maximum rate).

The risk of adverse effects on listed salmonids and their habitat was evaluated in terms of hazard quotient (HQ) values. Hazard quotient values are calculated by dividing the expected environmental concentration (expected exposure) by the effects threshold concentration (identified threshold) (Appendix D). For fish, the effects threshold was the no-observed-effect concentration (NOEC), used by the R6 2005 Biological Opinion. The NOEC is defined as representing the threshold of acute sub-lethal effects. Thus, when the HQ value is greater than one, then adverse effects on fish, in the form of acute sub-lethal effects, are likely to occur.

Hazard quotient values were also calculated for aquatic invertebrates, algae, and aquatic macrophytes. Threshold concentrations at which herbicides are likely to adversely affect aquatic invertebrates, algae, and aquatic macrophytes were equal to LC_{50} and EC_{50} concentrations. The LC_{50} values were used for aquatic invertebrates and some algal species, and EC_{50} values were used for the remaining algal species and aquatic macrophytes.

The LC_{50} and EC_{50} values for each species group were obtained from the risk assessments conducted by SERA for the FS. The values recommended in the risk assessments for "sensitive" species within each species group were used. The LC_{50} and EC_{50} values were frequently those for which toxicity data was required for EPA registration of the herbicide. If an HQ value exceeded one for algae or aquatic macrophytes an adverse effect to habitat was considered to occur.

Exposure from Riparian Application. This section addresses direct exposure risks to listed fish in both small streams and the margins of larger streams from runoff and percolation resulting from herbicide application in riparian areas. The analysis is based on the small stream scenario used in the risk assessments performed by SERA for the FS. The exposure scenario is for a 10 acre herbicide application adjacent to a small stream (base flow of 1.8 cfs).

Since several relevant parameters of the margins of larger streams are analogous to the modeled small stream scenario, the small stream analysis results are extended to stream margin habitat. Stream margins often provide shallow, low flow habitat, may 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 (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 a variety of reasons, including 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 through dissolution and into surface runoff, or into subsurface runoff through percolation through soils, and ultimately into stream channels. Soil erosion can also deliver herbicides from riparian applications.

Table 11 below summarizes the results of the small stream exposure analysis (see Appendix C for the full display of the small stream analysis). 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 ranging from 15 to 100 inches per year, typical and maximum herbicide application rates, and effects threshold concentrations to calculate HQ values for fish. These rainfall rates fall within the approximate annual precipitation rates on the east slope of the Cascade Mountains (approximately 35 inches of rainfall per year), west slope of the Cascade Mountains (50 to 90 inches of rainfall per year), and north shore of the Columbia River (approximately 80 inches of rainfall per year).

The peak WCR values predicted by soil type were used to calculate the likely range of HQ values at typical and maximum herbicide application rates for all three rainfall levels (15, 50, and 100 inches per year). Numerous factors contribute uncertainty to point estimates of WCR values, such as modeling assumptions and input parameters, (and thus HQ values). The HQ exceedancess for listed salmonids are discussed below by herbicide.

Table 11. Summary of exposure concentrations from riparian applications to small streams and stream margins, and salmonid HQ values based on typical and maximum herbicide application rates under the standard SERA risk assessment scenario.

		Riparian Application											
		Typical Application Rate						Maximum Application Rate					
		Clay		Loam		Sand		Clay		Loam		Sand	
Herbicide	Rainfall (inch/yr)	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value
Chlorsulfuron	15	0.0007	0.0003	0.00000	0.0000	0.00000	0.0000	0.003	0.002	0.00000	0.0000	0.00000	0.0000
	50	0.006	0.003	0.00002	0.0000	0.003	0.0004	0.03	0.01	0.0001	0.0001	0.003	0.002
	100	0.01	0.006	0.0001	0.0001	0.00000	0.001	0.05	0.02	0.0007	0.0003	0.009	0.004
Clopyralid	15	0.002	0.0003	0.00000	0.0000	0.00000	0.0000	0.002	0.0005	0.00000	0.0000	0.00000	0.0000
	50	0.004	0.0007	0.002	0.0005	0.006	0.001	0.005	0.001	0.004	0.0007	0.009	0.002
	100	0.004	0.0007	0.007	0.001	0.02	0.003	0.005	0.001	0.01	0.002	0.02	0.004
Glyphosate	15	0.002	0.02	0.005	0.05	0.01	0.1	0.009	0.09	0.02	0.2	0.05	0.5
	50	0.04	0.4	0.06	0.6	0.1	1.1	0.1	1.4	0.2	22	0.5	4.5
	100	0.1	1.1	0.2	1.5	0.3	28	0.4	42	0.6	62	1.1	11
Imazapic	15	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000
	50	0.00005	0.0000	0.00000	0.0000	0.00001	0.0000	0.00009	0.0000	0.00000	0.0000	0.00002	0.0000
	100	0.0001	0.0000	0.00001	0.0000	0.00002	0.0000	0.0002	0.0000	0.00002	0.0000	0.00004	0.0000
Imazapyr	15	0.00002	0.0000	0.00000	0.0000	0.00000	0.0000	0.00008	0.0000	0.00000	0.0000	0.00000	0.0000
	50	0.0003	0.0001	0.00000	0.0000	0.00007	0.0000	0.0009	0.0002	0.00000	0.0000	0.0002	0.0000
	100	0.0006	0.0001	0.00004	0.0000	0.0001	0.0000	0.002	0.0004	0.0001	0.0000	0.0005	0.0001
Metsulfuron	15	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00002	0.0000	0.00000	0.0000	0.00000	0.0000
	50	0.00004	0.0000	0.00000	0.0000	0.00001	0.0000	0.0002	0.0000	0.00001	0.0000	0.00004	0.0000
	100	0.00006	0.0000	0.00000	0.0000	0.00002	0.0000	0.0003	0.0001	0.00002	0.0000	0.00008	0.0000
Picloram	15	0.004	0.09	0.00000	0.0000	0.007	0.2	0.01	0.3	0.00000	0.0000	0.02	0.5
	50	0.03	0.9	0.004	0.1	0.02	0.4	0.1	25	0.01	0.3	0.05	1.2
	100	0.06	1.6	0.006	0.1	0.02	0.6	0.2	46	0.02	0.4	0.07	1.7
Sethoxydim	15	0.001	0.02	0.0004	0.007	0.006	0.1	0.002	0.03	0.0007	0.01	0.009	0.1
	50	0.02	0.3	0.04	0.6	0.03	0.5	0.02	0.4	0.06	1.0	0.04	0.7
	100	0.04	0.7	0.09	1.5	0.05	0.9	0.06	1.1	0.1	23	0.08	1.3
Sulfometuron	15	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000
	50	0.00002	0.0000	0.00000	0.0000	0.00000	0.0000	0.00002	0.0001	0.00000	0.0000	0.00000	0.0000
	100	0.00005	0.0000	0.00000	0.0000	0.00001	0.0000	0.00005	0.0001	0.00002	0.0000	0.00001	0.0000
Triclopyr	15	0.02	0.06	0.02	0.06	0.02	0.06	0.2	0.6	0.2	0.7	0.2	0.6
	50	0.1	0.5	0.09	0.2	0.05	0.2	1.3	48	0.9	36	0.5	21
	100	0.2	0.9	0.2	0.3	0.09	0.3	24	94	1.7	65	0.9	34

Shaded cells represent HQ values greater than one.

The data from the SERA risk assessments shows that modeled peak WCR values generally increased with higher application and rainfall rates. As mentioned above, the annual rainfall within the action area falls within those rates employed in this analysis.

The average annual rainfall rates in the action area approach but do not exceed 100 inches per year. Table 11 above shows that at typical application rates, HQ exceedances for glyphosate, picloram, sethoxydim and triclopyr occurred primarily at rainfall rates of 100 inches per year or greater. At maximum application rates glyphosate, picloram and triclopyr exhibited HQ exceedances at rainfall rates greater than 50 inches per year. As displayed in Table 11, under the riparian application scenario no HQ exceedancess occurred for fish from chlorsulfuron, clopyralid, imazapic, imazapyr, metsulfuron, or sulfometuron at any application rate or soil type.

Glyphosate HQ exceedancess occurred for fish at rainfall rates of 50 to 100 inches per year. The HQ values for fish at 50 inches per year were exceeded on all soil types and ranged from 1.4 to 4.5 at the maximum application rate. At the typical application rate, on sandy soils, the HQ value at the 50 inches per year rainfall rate was slightly exceeded. The HQ values for fish at 100 inches per year across all soil types exceeded the HQ values, ranging from 1.1 to 11 when applied at both the typical and maximum rates. Thus the risk of exposure of listed fish to glyphosate is likely to occur at those treatment sites that are located adjacent to perennial and wet intermittent streams.

Picloram HQ exceedances for fish occurred at rainfall rates of 50 through 100 inches per year, at typical and maximum rates, on clay and sand soil types. The HQ exceedances ranged from a low of 1.2 on sand soils, at the maximum application rate, and a rainfall rate of 50 inches per year. The highest HQ exceedance (4.6) occurred on clay soils, at the maximum application rate, with a 100 inch per year rainfall rate.

The sethoxydim HQ exceedances for fish occurred at rainfall rates of 50 through 100 inches per year, with HQ exceedance values ranging from 1.1 to 2.3. The HQ exceedance at 50 inches per year occurred only at the maximum application rate on loam soils. The HQ exceedance at 100 inches per year occurred only at the maximum application rates and at the typical application rate on loam soils.

Triclopyr HQ exceedancess occurred for fish at rainfall rates of 50 through 100 inches per year. The HQ exceedance values for fish at 50 inches per year ranged from 2.1 to 4.8, primarily at maximum application rates on all soil types. The HQ exceedance values for fish at 100 inches per year ranged from 3.4 to 9.4, across all soil types at the maximum application rate. The HQ exceedances were greatest on clay soils.

Exposure from Treatment of Dry Intermittent Channels and Ditches. Herbicides applied within ditches and intermittent stream channels are delivered to places where fish or their food might be exposed by leaching into soil, dissolving directly into ditch or stream channel flow (when present), and/or erosion of exposed soil. The contribution from erosion is likely to vary considerably among sites. Hand selective application of clopyralid, glyphosate (aquatic formulation), imazapic, imazapyr (aquatic formulation), metsulfuron methyl, and triclopyr (aquatic formulation) is proposed within ditches and dry intermittent channels. Hand selective methods up to the bankfull level are allowed for chlorsulfuron, imazapyr and sulfometuron methyl. Hand selective methods can be applied up to the maximum application rates in all instances. Spot spray application of glyphosate (aquatic formulation) and imazapyr is also proposed in ditches and dry intermittent channels. Spot spray of clopyralid, imazapic, and metsulfuron methyl are allowed up to the bankfull level. The primary determinants of exposure risk from ditch or intermittent channel treatments are herbicide properties, application rate, extent of application, application timing, precipitation amount and timing, and proximity to habitat for listed salmonids.

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 or intermittent channel runoff in the early stages of the storm hydrograph is generally low, but early runoff is exposed to the greatest amount of pollutants available for dissolution. The ratio of low discharge to highest amount of available pollutant results from the compositing of 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.

The effects on pollutant concentration of the first flush of water in previously dry channels are well understood. In contrast, the agencies have little monitoring data regarding specific concentrations of herbicides likely to occur in runoff from treated ditches. The USGS (2001) monitoring report 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 per acre, and resulted in runoff concentrations of 0.119 to 0.253 milligrams/liter (mg/l) (corresponding to about 3 to 7 percent of amount applied) from simulated rainfall 24 hours following application. Glyphosate was applied at a rate of about 2 pounds per acre, and resulted in runoff concentrations of 0.323 to 0.736 mg/l (corresponding to about 1 to 2 percent of amount applied) from simulated rainfall 24 hours following application. The samples consisted of 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 is likely to occur in runoff within 24 hours after application to ditches or dry, intermittent streams from "first flush" events for these herbicides (per amount applied, per unit area).

The likely herbicide runoff concentrations, for which data are not available (chlorsulfuron, clopyralid, imazapic, imazapyr, metsulfuron, sethoxydim, and triclopyr) 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}[6] 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 five days (sethoxydim), and the others are considerably longer, so it is reasonable to ignore half-life for estimating concentrations in runoff within 24 hours after application.

It is important to note that the USGS (2001) study also examined herbicide concentrations in water following natural rainfall events. Glyphosate was not detected in the roadside runoff following natural rainfall. However, the authors did not collect any samples during the first two rainfall events following the herbicide application, so the results are most relevant as an indicator of the long-term persistence of glyphosate in the environment, and do not represent a worse-case scenario of extensive roadside applications followed immediately by a rainfall event. Based on the results of the simulated rainfall experiments, the authors did calculate the potential herbicide concentrations within the adjacent stream channel under a worse-case scenario. These calculations resulted in a concentration of 0.0008 to 0.0018 mg/l of glyphosate within the stream (USGS 2001). These low concentrations are not unexpected, due to the dilution of roadside runoff within the stream and the fact that the calculations were based on roadside ditch treatment areas smaller than the proposed action. However, the concentration at a stream confluence may be significantly higher, and sufficient dilution may not occur for several meters below a stream confluence.

Table 12 summarizes herbicide soil mobility factors (solubility, and K_{oc} ratios) and application rates for the ten herbicides in the proposed action. The seven herbicides in the proposed action for which ditch runoff data is not available (chlorsulfuron, clopyralid, imazapic, imazapyr, metsulfuron, sethoxydim, and triclopyr) 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 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 per acre, the initial runoff only needs to reach 0.6 percent saturation to remove 10 percent 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 herbicides in the proposed action 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 herbicides will occur at a rate at least equal to that of sulfometuron following a rainstorm occurring 24 hours after application. This assumption is consistent with groundwater movement ratings from

[6] Koc is summarily defined as the ratio of chemical absorbed in soil per unit organic carbon, while in equilibrium with the chemical dissolved in aqueous solution.

Vogue et al. (1994). In addition, foliar wash-off fractions of these seven herbicides were also approximately equal to or 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]
Triclopyr	2,100,000	20	10
Imazapyr	500,000	100	1.5
Clopyralid	300,000	6	0.5
Metsulfuron	9,500	35	0.15
Chlorsulfuron	7,000	40	0.25
Sethoxydim	4,390	100	0.45
Imazapic	2,150	112	0.1875
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

Since the USGS (2001) study measured glyphosate runoff concentrations, and the K_{oc} value for glyphosate is well out of the range of the other herbicides, the glyphosate data were not used in estimating concentrations of the other herbicides. In addition, glyphosate is an anomaly in that the water solubility is high, yet sorption to soil organics, metals, and other soil components is also high (as reflected in K_{oc} values estimated in the thousands).

The USGS (2001) average sulfometuron concentration 24 hours after application was used to extrapolate likely concentrations of the herbicides for which comparable monitoring data was unavailable, predict exposure risk to listed salmonids and their habitat, and calculate HQ values. The equation for estimating the concentration of the remaining herbicides from the USGS (2001) sulfometuron 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:

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

Table 13. Summary of potential exposure concentrations and salmonid hazard quotient HQ values based on typical and maximum herbicide application rates in ditches/dry channels and applications within occupied streams.

	Ditch/Dry Channel Application				Instream Application											
	Typical Application Rate		Maximum Application Rate		Typical Application Rate						Maximum Application Rate					
Herbicide	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value	Conc in 1' of water	HQ Value	Conc in 1' water from emergent rinse	HQ Value	Conc in 1' water from emergent overspray	HQ Value	Conc in 1' of water	HQ Value	Conc in 1' water from emergent rinse	HQ Value	Conc in 1' water from emergent overspray	HQ Value
Chlorsulfuron	0.05	0.02	0.2	0.1												
Clopyralid	0.3	0.06	0.4	0.09												
Glyphosate	0.5	4.8	1.9	19	0.7	7.4	0.3	2.8	0.2	1.8	2.9	29	1.1	11	0.7	7.4
Imazapic	0.09	0.0009	0.2	0.002												
Imazapyr	0.4	0.08	1.3	0.3	0.2	0.03	0.1	0.02	0.04	0.01	0.6	0.1	0.4	0.07	0.1	0.03
Metsulfuron	0.03	0.01	0.1	0.03												
Sethoxydim	0.3	4.3	0.4	6.5												
Sulfometuron	0.03	0.01	0.3	0.07												
Triclopyr	0.9	3.3	8.7	33	0.4	1.4	0.3	1.0	0.1	0.4	3.7	14	2.6	10	0.9	3.5

Shaded cells represent HQ values greater than 1.

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).

Based on the foregoing discussion of method and the presentation in Table 13, glyphosate, sethoxydim, and triclopyr exceed the fish HQ threshold level of 1 causing likely adverse effects on listed salmonids from rain within 24 hours after application at ditch and intermittent channel confluences with perennial streams. For this consultation, NMFS assumed that this would occur for complete treatment of up to 660 feet of a ditch or dry channel that discharges to a perennial stream containing listed fish. During the first rain after application, the concentration of herbicides within the ditch would composite and subsequently increase (Huang et al. 2004). Of the known treatment areas in the GPNF fifth field watersheds with listed fish there are a total of 109 stream crossings within 660 feet of LCS streams. In this case, stream crossings are used as a reasonable representative for potential ditch treatments. Of those 107 treatment area stream crossings within 660 feet of a LCS stream, only 25 crossings directly over occupied LCS streams. The data do not show distinct trends. For example, the Upper Cowlitz River contains 381 total crossings in the treatment areas, the most for any of the fifth field watersheds in the action area however, that watershed has no crossings directly over LCS bearing streams within treatment areas, and only three crossings within 660 feet of LCS streams with the treatment areas (Appendix Table B3).

Of the known treatment areas in the CRGNSA fifth field watersheds with listed fish, there are a total of 22 stream crossings within 660 feet of LCS or MCS streams. As above, stream crossings are used as a reasonable representative for potential ditch treatments. Of those 107 treatment area stream crossings within 660 feet of LCS or MCS streams, the individual watershed data show distinct trends. For example, all of the stream crossings in both the Lower Klickitat River and Columbia Gorge Tributaries watersheds have all of their streams crossings within 660 feet of LCS or MCS bearing streams (Appendix Table B9).

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 or intermittent stream, application rate, extent of riparian applications, and rainfall timing, intensity, amount and efficacy of PDCs and buffers. Riparian applications adjacent to ditches or intermittent stream channels may contribute additional herbicide, exacerbating exposures at confluences with perennial streams.

NMFS interpreted the projected runoff concentrations and HQ values displayed in Table 13 mindful 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, the author states "it is important to recognize that all of the data presented are semi-quantitative 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.

Exposure from Applications within Perennial Streams. Under the proposed action, only glyphosate, imazapyr, and triclopyr can be applied within the bankfull level of perennial streams, including channel bars and emergent vegetation. Glyphosate and imazapyr can be applied up to typical application rates with spot spray, and all three herbicides can be applied up to the maximum application rates with hand selective methods.

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 of all life history stage. 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.

Table 13 above shows the potential HQ values for the three herbicides proposed to be applied within perennial streams. Values were derived for concentrations of the three herbicides in: 1) 1 foot of water (1 square foot floodplain area), 2) 1 foot of water after rainfall rinse from emergent vegetation, (the amount of glyphosate amount available for dissolution (62.5 percent of the amount applied) is based on assumptions of a foliar wash-off fraction of 0.5 (SERA 2003a), the imazapyr amount assumes a 0.9 foliar wash-off fraction (SERA 1999) and the triclopyr amount assumes a 0.95 foliar wash-off fraction (SERA 2003b)), and 3) 1 foot of water resulting from overspray of emergent vegetation (an assumed 25 percent overspray rate). Of the three, glyphosate exhibits HQ exceedances at both typical and maximum application rates for all three scenarios, and triclopyr exhibits HQ exceedances at typical and maximum application rates for all scenarios except emergent overspray at the typical rate. No HQ exceedances occurred for imazapyr.

Numerous factors influence the actual concentration in stream margins associated with an application site. These include application rate, herbicide properties, rainfall proximity and intensity, time since application, soil permeability, and water turbulence and flow rate. Concurrent applications of herbicides 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.

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." 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 below bankfull sites.

Exposure of listed fish from treatment of emergent plants is likely to occur via three pathways: overspray, foliar wash-off, and leakage of glyphosate from stem injections. Since delivery via each pathways is driven by different factors (overspray, rainfall, and plant death and breakage), exposure from all three pathways is very unlikely to overlap in time. However, since the proposed action does not contain any provisions for avoiding rainfall, overspray and foliar wash-off could occur concurrently.

Hazard quotient exceedances were determined for glyphosate and triclopyr, in all three below bankfull exposure scenarios. At the one foot depth, glyphosate HQ values for typical and maximum application rates are estimated to be 7.4 and 29, respectively. These HQ exceedances could be observed as a result of a rain event closely following herbicide treatment. For triclopyr at the one-foot depth, the HQ values for typical and maximum applications rates are estimated as 1.4 and14, respectively.

Exposure from the Early Detection and Rapid Response Program. The EDRR element of the proposed action prescribes how the GPNF and CRGNSA plan to respond to infestations that arise or are discovered in the future. The EDRR program treatment techniques are effectively the same as those for the known sites, but the scope of treatment is limited by PDC H14 in Table 4. The prescribed limitation is spatial and temporal. For invasive plant sites above bankfull, within the aquatic influence zone, treatments will not exceed 10 acres along any 1.5 mile length of stream reach within a sixth field subwatershed in any given year. For invasive plant sites below bankfull, treatments would not exceed a total of seven acres within a sixth field sub-watershed in any given year.

To strategically treat invasive plants, the GPNF and CRGNSA created a GIS database with mapped polygons identifying roads systems and other large areas that could be treated for invasive plants over the next 15 years. The database includes over 10,000 acres of mapped treatment areas located within the administrative boundary of the GPNF and over 1,100 acres of mapped treatment areas located within the administrative boundary of the CRGNSA. Within the GPNF, GIS data indicate that only 22 percent of the all the roads on the forest are located within treatment areas. In addition, only 2 percent of all the roads on the forest are located within treatments areas that are within 660 feet of LCS streams. That leaves some unidentified percentage of the 2,564 total road miles in the GPNF as potential EDRR sites that could be located within 660 feet of LCS streams (Appendix Table B5).

Within the CRGNSA, GIS data indicate that 54 percent of the all the roads on the scenic area are located within treatment areas. In addition, approximately 6 percent of all the roads on the scenic area are located within treatments areas that are within 660 feet of LCS or MCS streams. That leaves some unidentified percentage of the 85 total road miles in the CRGNSA as potential EDRR sites that could be located within 660 feet of LCS or MCS streams (Appendix Table B11).

According to GIS data, the GPNF has jurisdiction over 905,463 watershed acres (Appendix Table B6). Of those total acres the current total known treatment area acres, by sixth-field watershed with listed salmon, is 10,330 acres (Appendix Table B4), leaving 895,133 acres in the GPNF where invasive plants have yet to be identified. Within the total known treatment area acres, 2,772 are located in a 50 meter riparian buffer of mapped LCS streams. At present, the GPNF is aware of 256 treatment acres located in a 50 meter riparian buffer of mapped LCS streams, leaving 2,516 acres within a 50 meter riparian buffer of mapped LCS streams as potential EDRR program sites. The future maximum percentage of treatment acres could be less than 1 percent of the entire GPNF administered lands (remaining riparian acreage along mapped LCS streams divided by total remaining GPNF watershed acres).

The CRGNSA has jurisdiction over 27,852 watershed acres (Appendix Table B12). Of those total acres the current total known treatment area acres, by sixth-field watershed with listed salmon, is 1,116 acres (Appendix Table B10), leaving 26,736 acres in the CRGNSA where invasive plants have yet to be identified. Within the total known treatment area acres, 170 are located in a 50 meter riparian buffer of mapped LCS or MCS streams. At present, the CRGNSA is aware of 66 treatment acres located in a 50 meter riparian buffer of mapped LCS or MCS streams, leaving 104 acres within a 50 meter riparian buffer of mapped LCS or MCS streams as potential EDRR program sites. The future maximum percentage of treatment acres could be less than 1 percent of the entire CRGNSA administered lands (remaining riparian acreage along mapped LCS or MCS streams divided by total remaining CRGNSA watershed acres).

The same data (Appendix Table B5) have indicated a total number of road miles within GPNF watersheds are 2,564 miles, and within CRGNSA watersheds are 85 miles. Of those miles on the GPNF, the total number of road miles located within treatment areas are 564 miles. On the CRGNSA, the total number of road miles located within treatment areas is 6 miles. The existing number of road miles within treatment areas on the GPNF represents 22 percent of the total road miles, and 54% of total road miles on the CRGNSA. The number of road miles located on the GPNF within 660 feet of LCS streams is 46 miles (Table B3), and on the CRGNSA the number of road miles within 660 feet of LCS or MCS streams is 2 miles (Table B9). The GPNF and CRGNSA have estimated the rate of future spread of invasive plants at between 5 to 12 percent per year. Thus future infestations could occur on many roads within the forest and scenic area.

The Relationship Between Exposure and Effects of the Action

During consultation, the GPNF, CRGNSA, and NMFS disagreed over the effects of the action beyond those from riparian and below-bankfull applications. To complete this consultation, NMFS considered the risks of exposure to all four endpoints, fish, aquatic invertebrates, algae, and aquatic macrophytes, relying on the GPNF and CRGNSA analysis of riparian and below bankfull applications only, and further examining the risks from treatment of ditches and intermittently dry channels proximal to confluences with flowing streams.

To initiate consultation, the GPNF and CRGNSA employed the toxicity thresholds for listed fish as they were known in September 2005. At that time, the exposure endpoints for glyphosate without surfactant, as described by the best available science, were the following.

Table 14. Acute and chronic endpoints for glyphosate.

Duration	Endpoint	Dose	Species	Effect Noted at LOAEL[1]
Acute	NOEC[2]	0.5 mg/l (1/20th/LC50)	Rainbow Trout	LC50 at 10mg/l
Chronic	NOEC	2.57 mg/l[3]	Rainbow Trout	Life-cycle study in minnow; LOAEL not given

[1] LOAEL – Lowest observed adverse effect level- The lowest dose associated with an adverse effect.
[2] NOEC – No observed effect concentration – The exposure level at which there are no statistically or biologically significant differences in the frequency or severity of adverse effects between the exposed population and its appropriate control.
[3] Estimated from minnow chronic NOEC using the relative potency factor method (SERA 2003a).

The value of glyphosate acute NOEC (0.5mg/l) represents a fraction of the known LC_{50}. This method is often used when measured NOECs are unavailable. Recently, Tierney et al. (2006) researched the ability of glyphosate to impair salmonid parr olfactory function. This endpoint was used as numerous studies have determined that olfaction can be affected by pesticide exposure. Olfaction is behaviorally indispensable as it enables behaviors such as imprinting and subsequently return migration. The investigators found that at a glyphosate concentration (glyphosate acid of 99 percent purity) of 0.1 mg/l the changes in the salmon electro-olfactogram during a 30 minute exposure and 60 minute recovery period did not differ from the control. However, other glyphosate concentrations, ranging from 0.1 mg/l to 100 mg/l, showed significant neurophysiological effects through the impairment of olfaction. As Tierney and researchers state: "because olfaction is tantamount to survival for anadromous salmonids, this sublethal toxicity endpoint would need to be considered in determining the no-observed-adverse-effect concentration (NOAEC). An olfactory NOAEC may be of regulatory use and serve to help preserve salmonid stocks, especially those at risk" (Tierney et al. 2006). This study represents the best available science reporting on the adverse effects of glyphosate, primarily as it provides empirical data versus estimation. Thus, this Opinion will replace the glyphosate effects threshold of 0.5 mg/l with 0.1 mg/l (Table 14).

Effects of Exposure to Physical Treatments Manual, Mechanical, and Restoration
As described above in the Exposure analysis, physical treatments will be carried out by workers in and near streams leading to possible physical contact and disturbance by proximity. In addition, the treatments themselves will remove vegetation, exposing soil to erosion with subsequent water quality effects. Finally, removal of even undesirable vegetation can reduce shade where the removed vegetation was the sole source of shade in the place it is removed. Each of these eventualities is considered remote and accruing effects will be extremely small in the scope of the overall program.

Where people work in and around streams to complete treatments, physical contact and proximity may injure or kill fish or incubating eggs or fry. In addition, proximity may change normal local behavior, causing some fish to move in an effort to seek alternative and possibly suboptimal habitat for cover and juvenile forage. Fish that seek suboptimal forage and cover will experience increased behavioral stress (avoidance, displacement), and sub-lethal responses (increased respiration, reduced feeding success, reduced growth rates). Below bankfull width of treated stream sides, treatment activities are likely to cause some physical injury or death to juvenile fish that do not leave the activity area. In addition, physical effects of weed removal, including unintended effects on non-target plant species, could potentially affect riparian functions such as shade, cover, and sediment filtering.

Physical treatments such as hand pulling will most likely only occur in areas with limited invasive vegetation given the inefficiency of the activity. Where they do occur, water quality could change causing some juveniles and adults to seek alternative habitat, which is likely to contain suboptimal cover and juvenile forage. Effects would be the same as for avoidance of human proximity, above. In addition, fish exposed to turbid water that stay put can experience a variety of sub-lethal physical responses (increased respiration, reduced feeding success, and/or reduced growth rates). As also mentioned previously, the extent of water quality change wrought by the proposed action from physical treatments will cause insignificant localized turbidity. In addition, the program ensures limitation of accrued effects by limiting extent of program activities both spatially and temporally.

Finally, the proposed action removes some riparian vegetation. Where removed vegetation is the sole source of local shade, exposure to solar radiation could warm water. 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 viability 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). These results of vegetation removal are considered extremely remote. As noted in the environmental baseline section, places in and around the action area with elevated average stream temperatures occur mainly from other factors such as regional topography and water diversion for municipal use. Any effects from the proposed action would be minor and would add imperceptibly to the existing environmental baseline condition.

Effects of Exposure to Physical and Chemical Treatments from Cultural Grazing with Goats. The cultural treatment included in the proposed action is the use of goats for grazing invasive weeds on the 55 acre Saint Cloud/Sam Walker site on the Columbia

River Gorge National Scenic Area (treatment #22-03, see GPNF and CRG SA DEIS Appendix A). Two streams (referred to as Goodbear and Archer Creeks) flow through the St. Cloud/Sam Walker site. Significant channelization and diking of the delta system, along with flooding, has impacted the streambed at the confluence of Goodbear and Archer Creeks. A fish barrier has developed as a result of the removal of native vegetation allowing black berries to grow extensively through the cobbles on the streambed. The dense thickets of blackberries are presently catching sediment causing excessive aggradation of the streambed, which is causing the stream to widen and downcut around the aggraded areas.

If grazing or other actions of goats (wallowing, wandering) were not controlled, their presence could cause damage to the stream system, and promote the spread and survival of invasive plants. Overgrazing can reduce native plant cover, disturb soils, weaken native communities, and allow exotic plants to invade. In addition, animals that are moved from one location to another can spread invasive plant seeds. Since the understory vegetation at the St. Cloud/Sam Walker site is nearly devoid of native vegetation and fish only have access to the channel at higher flows, a reduction of cover provided by the invasion of blackberries is not a concern. The overstory canopy is all native vegetation. The 1996 floods removed productive soils along the streambank, allowing the blackberry root systems to aggrade the channel with gravel and small cobble. The lack of soils within the area eliminates any erosion potential. Several years of intensive grazing followed by annual brief periods of grazing by the same grazing species may be required to gain and maintain control of an infestation.

Because goats tend to eat a great variety of plants, methods (i.e: herding, fencing, or the placement of salt licks) will be employed to concentrate their grazing activities in the St. Cloud/Sam Walker site.

Some goat manure would get in the stream but this would be a temporary effect as the goats would be kept at the site a short (few weeks) time. Due to heavily wooded and wet conditions, mechanical treatment is not possible here. Goats could be used to reduce the infestation and weaken the plants before hand treatment with herbicides. This would lower the amount of herbicide used within the riparian area. In general, grazing can be effective in reducing a large infestation or eliminating a smaller infestation. By treating the invasives first with grazing impacts on the site from other treatments will be lowered. Any effects from the proposed action of grazing would be minor and would add imperceptibly to the existing environmental baseline condition.

Effects of the Action from Exposure to Herbicides (Toxicity). The toxicological effects of each of the herbicides proposed for use are summarized in Appendix A. Toxic effects may potentially harm listed fish by killing them outright, through sublethal changes in behavior or physiology, or indirectly through a reduction in the availability of prey (Scholz et al. 2005). Although outright lethality is unlikely to occur from the proposed action, in locations where herbicides reach the water, salmon and steelhead may be harmed though sublethal effects or indirectly though toxic effects on other aquatic organisms. Sublethal effects from water contamination by herbicides cannot be discounted based on the available information. Water contamination by herbicides is likely to occur in occasional locations on the GPNF and CRGNSA, and sublethal effects of herbicides or their adjuvants can occur within the range of concentrations likely to occur under the proposed action. Sublethal effects on salmon and steelhead, 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 exceedances, are reasonably likely to occur. When treatments occur that utilize two or more herbicides in close proximity, exposures to mixtures may follow. Where sublethal assays have been reported for salmonids, harmful effects occur at concentrations as much as several orders of magnitude less than the lethal endpoints used by EPA to assess pesticide risk (Scholz et al. 2000).

RiparianApplication. All of the SERA risk assessments used a treatment site scenario of 10 acres of broadcast treatment. The GPNF and CRGNSA interpreted this to say that the WCR values from the risk assessments are overestimates of exposure to herbicide runoff and percolation when application methods other than broadcast are used. However, NMFS has observed that numerous sources of uncertainty are inherent in the WCR values in the risk assessments. The validity of the assertion that a single parameter (application method) outweighs the cumulative influence of all other sources of exposure uncertainty, and provides a basis for discounting adverse effects as indicated by HQ exceedances, is not documented. Numerous environmental factors are known to exist that can result in variation of the actual WCR values from those predicted (USDA Forest Service 2005a; Berg 2004). Based on the lack of documentation regarding the uncertainty explained by application method in the context of all other sources of uncertainty, WCR-based HQ values greater than 1 are considered to represent an adverse effect in this Opinion. In addition, differences between site conditions and those modeled tend to result in actual herbicide delivery rates exceeding those modeled (Berg 2004). As a result of these uncertainties, an HQ value greater than 1, based on application rate, soil, and annual rainfall, is considered to represent an adverse effect in this Opinion.

Application of glyphosate adjacent to stream channels at maximum application rates in areas of greater than 50 inches of rainfall per year is likely to adversely affect listed salmonids when applied by hand selective methods on all soil types (Table 11). Application of glyphosate adjacent to stream channels at rates greater than typical in locations of 100 inches of rainfall per year is likely to adversely affect listed salmonids on all soil types. Risks to listed salmonids from spot spraying and hand selective exist in watersheds with rainfall approaching 100 inches per year. Application of glyphosate adjacent to stream channels at typical rates in areas of 100 inches of rainfall per year is likely to adversely affect listed salmonids, and application of glyphosate adjacent to stream channels at maximum rates in areas of between 50 and 100 inches of rainfall per year is likely to adversely affect listed salmonids.

Riparian application of picloram on soils other than loam is likely to adversely affect listed salmonids. The 50-foot and greater application buffer for picloram in the proposed action, as well as its prohibition on high risk road segments, last priority for use within aquatic influence zones, and no use on soils coarser than loam will reduce the likelihood and magnitude of the predicted adverse effects on fish, and is likely to eliminate any predicted adverse effects on aquatic macrophytes.

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 generally 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 (SERA 2001). Given the properties of the naptha solvent discussed above, and the 50-foot application buffer for sethoxydim which is likely to reduce the amount of naphtha solvent, the sethoxydim concentrations reaching the stream system are likely biologically insignificant.

Application of triclopyr adjacent to stream channels at rates approaching the maximum in areas of 50 to 100 inches of rainfall per year is likely to adversely affect listed salmonids on all soil types. Application of triclopyr adjacent to stream channels at maximum rates in areas of between 50 and 100 inches of rainfall per year is likely to adversely affect listed salmonids.

Table 11 shows that glyphosate and triclopyr, when applied at both the typical and maximum application rates are likely to cause sublethal effects on listed salmonids, generally reducing their fitness and in the case of glyphosate, impairing their olfactory function. The conclusion of effects from triclopyr exposure is based primarily on use of maximum application rates employed by hand selective methods, in locations with rainfall rates between 50 to 100 inches per year. Effects from application of glyphosate at both typical and maximum rates are also likely to cause effects on listed salmonids. Appendix B identifies the list of known treatment sites located within the subwatersheds. While the invasive plants on those sites have not been identified, the ubiquitous nature of glyphosate and/or triclopyr makes it likely that they (Appendix A and Common Control Measures document of the 2006 GPNF and CRGNSA DEIS) could potentially be applied in the riparian zone at every one of the known treatment sites.

Application in Dry Ditches and Intermittent Channels. Table 13 shows that glyphosate sethoxydim, and triclopyr, when applied at both the typical and maximum application rates are likely to cause sublethal effects on listed salmonids, generally reducing their fitness and in the case of glyphosate, impairing their olfactory function. Given the properties of the naptha solvent discussed above, and the 50-foot application buffer for sethoxydim which is likely to reduce the amount of naphtha solvent, the sethoxydim concentrations reaching the stream system are likely biologically insignificant.

The attainment of HQ values presented in Table 13 is likely caused by herbicide application to a segment of ditches or dry channels in either of two ways. Either application directly adjacent to the confluence with a perennial stream with listed fish or critical habitat present, or treatment of up to 660 feet of dry ditch or intermittent channel separated from the perennial channel by an appropriate buffer would have to occur (Tables 5 and 6). Tables B3 and B9 in Appendix B support the likelihood of these conditions by showing that in over half of the watersheds in the action area many of the known treatment sites either have at least a road crossing an LCS or MCS occupied stream, a crossing of a tributary closer than 660 feet to an LCS or MCS occupied stream, or an LCS or MCS occupied stream of some length within the treatment area. Because the BA does not identify specific herbicide type, application method or rate for the treatment areas, the assumptions in this Opinion are that listed salmonids could be exposed to these three herbicides as a result of the treatment of dry channels and ditches. 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 ditches or intermittent channel lengths greater than a few hundred feet at the typical rate are likely to be infrequent. However, given the scope of the proposed action and the uncertainty of occurrence, listed individual salmonids could be exposed to and affected by glyphosate and triclopyr from these applications.

Application within Perennial Streams: The application of glyphosate and triclopyr at typical and maximum application rates within perennial channels is likely to adversely affect listed salmonids. While the PDCs preclude application methods that would disturb spawning fish or redds, application of herbicides can occur while salmonids are rearing and migrating. In addition, Table 13 shows HQ exceedances of herbicides in 1 foot of water and for only a fraction of 1 foot of water representing foliar wash-off. Wash-off occurs as a result of rainfall. The proposed action does not contain a PDC limiting herbicide applications to periods outside of rainfall events. Herbicide labels frequently do not address application timing relative to rainfall, or conversely recommend irrigation for increased efficacy. This Opinion thus assumes that herbicide application can occur during periods of rainfall, causing the HQ values for glyphosate and triclopyr to potentially additively increase. If listed fish are in the system at the time of herbicide application, they could experience loss of olfactory capability, among other effects, which would hinder their ability to detect and avoid predation.

At this time, there are five known treatment sites in the GPNF and CRGNSA that may include invasive plant treatments below bankfull as well as above bankfull elevations. The treatment site on the GPNF is located upstream of an impassable barrier, and is located out of potential exposure to listed salmonids. Thus, treatment of the known sites on the GPNF will not expose listed salmonids to adverse effects.

However, some of the known treatment sites that may include treatment below bankfull on the CRGNSA could expose listed salmonids to adverse effects. The Hot Springs site (treatment area #22-04), adjacent to Duncan Creek, is tributary to the Columbia River, and is known to support LCS spawning. In addition, the St. Cloud/Sam Walker site (treatment area #22-03), adjacent to Greenleaf Creek and tributary to the Columbia River, is known to support LCS and LCRC spawning. According to the analysis in the BA, estimated peak concentrations of glyphosate and triclopyr within 1 cubic foot of water can result in exceedances of the acute toxicity indices for fish. Imazapyr also exceeded the acute toxicity indices for algae and macrophytes (Table 15). Since the analyses in the BA were run using the typical application rates for the three herbicides, and since hand/select methods allow for application rates up to maximum allowed on the herbicide labels, the potential exeedances of the acute toxicity indices could be even greater than identified in Table 15. If listed fish are in the system at the time of herbicide application at these treatment sites, they could experience loss of olfactory capability, among other effects, which would hinder their ability to detect and avoid predation. Treatment of these sites will expose listed salmonids to adverse effects.

Table 15 - Comparison of Estimated Peak Concentrations within 1cubic foot of water to Acute Toxicity Indices

Aquatic formulations at typical application rate	Estimated Peak concentration on 1 cubic foot of water	Acute toxicity indices			
		Fish	Invertebrates	Algae	Macrophytes
Glyphosate	0.735 Mg/L	**0.1** Mg/L (1/20th of LC50)	78 Mg/L (1/10th of LC50)	3 Mg/L (NOEC)	3 Mg/L (NOEC)
Imazapyr	0.552 Mg/L	5 Mg/L (1/20th of LC50)	100 Mg/L (NOEC)	**0.02** Mg/L (1/10th of EC50)	**0.013** Mg/L (EC25)
Triclopyr	0.368 Mg/L	**0.26** Mg/L (1/20th of LC50)	13.3 Mg/L (1/10th of LC50)	4.2 Mg/L (NOEC)	0.42 Mg/L (1/10th of EC50)

Bolded values indicate exceedance of acute toxicity indices.

Applications under Early Detection and Rapid Response. The EDRR program could include manual, mechanical, or restoration treatment methods, as well as application of the ten authorized herbicides within the riparian zone, six of the herbicides within dry channels and ditches and three within perennial streams. The program limits the spatial and temporal scope of EDRR program treatments (PDC H14, Table 4). To calculate the extent of this limitation for this consultation, the agencies conducted spatial analysis of the maximum treatment permitted under the EDRR program.

For treatments above bankfull, each 1.5 stream mile segment could receive treatment on up to 54 total acres. However, the EDRR program limits treatments to not more than 10 acres along any 1.5 miles of stream in any given sixth field subwatershed, thereby confining the treatment area to no more than 18.5 percent of the total above bankfull acreage within a 1.5 stream mile segment. Given the application of PDCs and buffers, application of herbicides above bankfull under the EDRR program will not expose listed salmonids to adverse effects.

For the analysis of treatments below bankfull, a number of assumptions were included. Average stream width for sixth field subwatersheds was assumed to be 20 feet. Thus, seven below bankfull acres was translated to 2.89 miles (Table B15, Appendix B). Tables B7 and B13 (Appendix B) illustrate the range of estimated below bankfull acres in each fifth field watershed across the GPNF and CRGNSA, as well as the estimated percentages of maximum below bankfull acres able to be treated in any given year (PDC H14). The potential average percent of below bankfull stream area proposed to be treated across all fifth field subwatersheds in the GPNF is 2.32 percent. The range within the fifth field watersheds is 1.13 percent in the North Fork Toutle River to 7.47 percent in the Washougal River. Of the watersheds that have the highest potential impacts from treatment of known sites, the East Fork Lewis River, the Lower Cispus River, Upper Cowlitz River, and the Upper Cispus River, have average potential EDRR program annual below bankfull treatments ranging from 4.98 percent to 1.80 percent (Table B7). If listed fish are in the system at the time of herbicide application, they could experience loss of olfactory capability, among other effects, which would hinder their ability to detect and avoid predation. Treatments below bankfull under the EDRR program on the GPNF have the potential to expose listed salmonids to adverse effects.

The potential average percentage of below bankfull stream area proposed to be treated across all fifth field subwatersheds in the CRGNSA is 28.99 percent. The value is inflated because many of the fifth field watersheds on the CRGNSA have very few stream acres, and those acres are less than the maximum annual below bankfull acres proposed to be treated. The Washougal River, Middle Columbia/Eagle Creek, White Salmon River, and Middle Columbia/Mill Creek watersheds have, in some cases, orders of magnitudes less below bankfull acres than the annual amount proposed under the EDRR program. There are three watersheds that contain more below bankfull acres than the maximum annual below bankfull acres proposed for treatment and they are: Columbia Gorge Tributaries, Middle Columbia/Grays Creek, and the Wind River (Table B13). Despite the great variation between watersheds, if listed fish are in the system at the time of herbicide application, they could experience loss of olfactory capability, among other effects, which would hinder their ability to detect and avoid predation. Treatments below bankfull under the EDRR program on the CRGNSA have the potential to expose listed salmonids to adverse effects.

The EDRR program has the potential, over the next fifteen years, to treat sites that cross or are within proximity to fish bearing water. Given the low percentage of total roads in the known GPNF treatment areas (22 percent, Table B5), approximately 88 percent of the existing roads have the potential to be included in future EDRR program sites. Of those 88 percent, some number will cross streams either directly or in close proximity. A number of assumptions, found in Table B8, were applied to determine the following values. On the GPNF, the predicted potential EDRR program stream crossings is 5821. Approximately 416 of those crossings could occur within 660 feet of an LCS bearing stream. In addition, approximately 95 of those 416 crossings could occur directly over LCS bearing waters. Future frequency of treatments of road ditches greater than a few hundred feet is uncertain. Given the potential scope of the EDRR progam in addition to the uncertainty of occurrence of listed individual salmonids, exposure to and adverse affects by glyphosate and triclopyr from these applications are likely to occur. Treatments of road ditches under the EDRR program on the GPNF have the potential to expose listed salmonids to adverse effects.

The potential percentage of existing roads that may be included in the EDRR program sites on the CRGNSA over the next fifteen years is less than the GPNF. With approximately half of all of the total roads on the CRGNSA located within treatment areas (54 percent, Table B11), approximately 46 percent of the existing roads have the potential to be included in future EDRR program sites. Of those 46 percent, some number will cross streams either directly or in close proximity. A number of assumptions, found in Table B14, were applied to determine the following values. On the CRGNSA the predicted potential EDRR program stream crossings is 90. Approximately 72 of those crossings could occur within 660 feet of an LCS bearing stream. Future frequency of treatments of road ditches greater than a few hundred feet is uncertain. Given the potential scope of the EDRR program in addition to the uncertainty of occurrence of listed individual salmonids, exposure to and adverse affects by glyphosate and triclopyr from these applications are likely to occur. Treatments of road ditches under the EDRR program on the CRGNSA have the potential to expose listed salmonids to adverse effects.

Additive or Synergistic Interactions of Mixtures of Chemicals. Additive or synergistic interactions with other chemicals are possible for both in-tank and in-situ mixing between upstream and downstream emergent treatment or surface and/or subsurface run-off. The GPNF and CRGNA do not propose to use mixtures for the 2007 spray year, but the proposed action leaves open the opportunity to tank mix herbicides as the need arises.

Exposures to expected maximum concentrations of the other herbicides in the activity description are not likely to result in adverse effects on listed fish given the patchy nature of infestations. If mixing does occur, 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 ten herbicides contained in the proposed action, but effects on 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.

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 to volatilization of the naphtha solvent (the primary toxic ingredient of the formulated product), the cumulative HQ values for the ten herbicides under realistic co-exposure scenarios are not likely to exceed that for below bankfull application exposure in stream margins. The GPNF and CRGNSA will employ a mixture analysis (identified in Appendix B of the BA) if tank mixtures are proposed to be utilized.

Response of Fish to Effects of the Action

Most toxicological effects of the proposed action on salmon and steelhead are likely to be from sublethal exposure to herbicides, rather than outright mortality from herbicide exposure. Effects such as fish killed as a result of sub-lethal changes impairing normal behavioral patterns, otherwise known as ecological death could occur. Furthermore, some exposed fish will not respond in any observable or measurable way. The herbicide formulations proposed for use generally have not been tested to determine their effects on essential behavioral patterns or their underlying physiological processes. It is important to note that many sublethal toxicological endpoints or biomarkers may harm fish in ways that are not readily apparent. When small changes in the health or performance of individual fish are observed (e.g., a small percentage change in the activity of a certain enzyme, an increase in oxygen consumption, the formation of pre-neoplastic hepatic lesions, etc.), it may not be possible to infer an impaired normal behavioral pattern, even in circumstances where a significant loss could occur. Where sublethal tests have been conducted, they are typically reported for individual test animals under laboratory conditions that lack predators, competitors, certain pathogens, and numerous other hazards found in the natural environment that affect the survival and reproductive potential of individual fish.

The lethal endpoint has little predictive value for assessing whether pesticide exposure will cause sublethal neurological and behavioral disorders in wild salmon (Scholz et al. 2000), but in most cases, the LC_{50} is the only toxicity data available. Although little information is available on the sublethal effects of the herbicides on listed fish, there can be subtle sublethal effects that can potentially affect the survival or reproduction of large population segments. For example, Scholz et al. (2000), and Moore and Waring (1996) indicate that environmentally relevant exposures to diazinon can disrupt olfactory capacity in the context of survival and reproductive success of Chinook salmon, both of which are key management considerations under the ESA (Scholz et al. 2000, Tierney et al. 2006).

The ecological significance of sublethal toxicological effects on individual fish depends on the degree to which essential behavior patterns are impaired, and the number of individuals exposed to harmful effects. Sublethal effects could compromise the viability and genetic integrity of wild populations if the effects are widespread across an entire DPS or ESU, or if localized exposures result in the concentrated loss of fish in a geographic area occupied by a local population with unique genetic traits. The likelihood of population effects from sublethal effects of the chemicals in the proposed action are largely undocumented, but appreciable population effects can be ruled out if the potential exposure to harmful effects is limited to small numbers of fish and a spatial pattern that is not likely to cause the loss of a unique genetic stock.

Weis et al. (2001) reviewed published literature on consequences of changes in behavior of fish from exposure to contaminants and noted studies reporting impaired growth and population declines from altered feeding behavior and impaired predator avoidance. Potential sublethal effects, such as those leading to a shortened lifespan, reduced reproductive output, or other deleterious biological outcomes are a potential threat to listed species from the proposed action.

The toxicological endpoints identified below are possible for a variety of pesticides and are generally considered to be important for the fitness of salmonids and other fish species. They include:

- Direct mortality at any life history stage;
- An increase or decrease in growth;
- Changes in reproductive behavior;
- A reduction in the number of eggs produced, eggs fertilized, or eggs hatched;
- Developmental abnormalities, including behavioral deficits or physical deformities;
- Reduced ability to osmoregulate or adapt to salinity gradients;
- Reduced ability to tolerate shifts in other environmental variables (e.g. temperature or increased stress);
- An increased susceptibility to disease;
- An increased susceptibility to predation; and,
- Changes in migratory behavior.

Most of these endpoints have not been investigated for the herbicides used in the proposed action.

Adverse effects on individual listed fish could result from herbicide applications. Adverse effects such as increased respiration, reduced feeding success, and subtle behavioral changes that can increase predation risk to individuals will occur. Specifically, adverse effects from glyphosate such as diminished olfactory capacity, leading to increased predation risk will occur.

The GPNF and CRGNSA propose to treat a number of known sites within each watershed containing populations of LCS, LCC, LCRC, MCS, and CC. For the all of the known sites, the application rates and methods vary in the likelihood of causing adverse effects on individual listed fish. In the GPNF, most (greater than 85 percent) of the known sites occur along roadways. In the CRGNSA, most of the known sites occur in clearings, fields, grasslands, and in recreational sites. For the GPNF, the overall percentage of all treatment area stream crossings that are within 660 feet of a LCS stream is 7 percent (Table B3, Appendix B), while that percentage is much greater in the CRGNSA (81 percent, Table B9). Also for the GPNF, across all fifth field watersheds that contain LCS, only 2.5 percent of the total known treatment acres fall within the 50 meter riparian buffer (Table B4, Appendix B) and 6 percent of the total know treatment acres fall within the 50 meter riparian buffer on the CRGNSA (Table B10, Appendix B). As such, the potential effects on listed salmon and steelhead from known riparian treatments are likely to be limited to rare, minimizing the potential for adverse effects on populations.

The EDRR program will limit the number of treatment acres above bankfull within any 1.5 mile stream segment within a sixth field sub-watershed in any given year. The EDRR program analysis yielded a potential riparian treatment area of up to 18.5 percent of the stream acreage within each sixth field subwatershed that could be treated annually. Given the breadth of PDCs, such as specific buffer widths and spatial limitation by individual herbicides, the likelihood of adverse effects on individual listed fish from riparian treatments of EDRR sites is low. Thus, the total number of invasive plant treatment projects that could occur above bankfull in a sub-watershed in any year, even when incorporating all the aggregate short-term negative effects, is not likely to adversely affect fish lifespan, reproductive output, predation risk, population structure or levels, or interfere with overall watershed function. These prescriptions taken together were designed to ensure that these effects do not aggregate as a result of these treatments.

The EDRR also limits the number of acres proposed to be treated below bankfull to seven acres within a sixth field sub-watershed in any given year. As such, EDRR program below bankfull has the potential to adversely affect listed LCS, LCC, LCRC, MCS, and CC in some subwatersheds. As seen in Table B7, Appendix B, the percent of below bankfull acres treated annually at the fifth field watershed scale in the GPNF could reach approximately 7.5 percent in the Washougal River. All other fifth field watersheds could experience less than five percent of the below bankfull acres treated annually. The weighted average of below bankfull acres treated annually across the entire action area would not exceed 2.32 percent. The percent below bankfull acres potentially treated on the CRGNSA ranges wildly (Table B13). In those watersheds with stream acres greater than the maximum below bankfull acres treated, the values range from 5 to 30 percent (Wind River, Middle Columbia/Grays Creek, and Columbia Gorge Tributaries watersheds). On the remaining watersheds, the total stream acres will limit the maximum annual below bankfull treatments. The greatest could occur on the Little White Salmon River watershed which has 6.3 total stream acres within the CRGNSA (Table 19).

All five species LCS, LCC, LCRC, MCS, and CC are found on a majority of the fifth field watersheds on the GPNF and CRGNSA. As seen in the status of the species section above, the short-term productivity varies for these species: 0.99 for LCC, between 0.92 and 1.23 for CC, 0.96 for LCS, and 0.94 for MCS. Productivity data for LCRC were not found, however, it is known that there are only two existing populations which reproduce naturally and they are located in watersheds in Oregon. In addition, all of the Washington LCRC fish contain hatchery spawners making the determination of extinction risk difficult. The short-term productivity for those fish found on the GPNF and CRGNSA indicates that they all need incremental increases in productivity to achieve low extinction risks. In other words, they are at some risk of extinction from habitat perturbations.

In addition to effects of direct exposure on listed fish, indirect effects of reduced food sources through the effects herbicides on aquatic non-target species, primarily in the form of reduced algae production and reduced aquatic macrophyte production can occur. The likelihood of adverse indirect effects is dependent on environmental concentrations, bioavailability of the chemical, and persistence of the herbicide in salmon habitat. For most pesticides, including the chemicals in the proposed action, there is limited information available on environmental effects such as negative impacts on primary production, nutrient dynamics, or the trophic structure of macroinvertebrate communities.

Most available information on potential environmental effects must be inferred from laboratory assays conducted on a specific target endpoint; although a few observations of environmental effects are reported in the literature. Due to the paucity of information, there are uncertainties associated with the following factors: 1) The fate of herbicides in streams; 2) the specific effects on, and resiliency and recovery of aquatic communities; 3) the site-specific foraging habits of salmonids and the vulnerability of key prey taxa; 4) the effects of pesticide mixtures that include adjuvants or other ingredients that may affect species differently than the active ingredient; and 5) the mitigating or exacerbating effects of local environmental conditions.

Indirect effects of chemicals used to treat invasive plants on ecosystem structure and function are a key factor in determining a toxicant's cumulative risk to aquatic organisms (Preston 2002). Moreover, aquatic plants and macrophytes are generally more sensitive than fish to acute toxic effects of herbicides. Therefore, chemicals can potentially affect the structure of aquatic communities, at the primary production level, at concentrations below thresholds for direct impairment in salmonids.

Availability of food is essential to rearing and migrating fish and is an essential element of those PCEs of critical habitat. The decrease in primary productivity of streams and rivers resulting from herbicide applications will vary in space and in time. Detrimental effects on primary production have direct effects on aquatic invertebrates. Juvenile Pacific salmon feed on a diverse array of aquatic invertebrates, with aquatic insects, and crustaceans comprising the large majority of the diets of fry and parr in all salmon species (Higgs et al. 1995). Prominent taxonomic groups in the diet include Chironomidae (midges), Ephemeroptera (mayflies), Plecoptera (stoneflies), Tricoptera (caddisflies), and Simuliidae (blackfly larvae) as well as amphipods, harpacticoid copepods, and daphniids. Chironomids in particular are an important component of the diet of nearly all freshwater salmon fry (Higgs et al. 1995). With a few exceptions (e.g. daphniids), the impacts of pesticides on salmonid prey taxa have not been widely investigated.

Factors affecting prey species are likely to affect the growth of salmonids, which is largely determined by the availability of prey in freshwater systems (Mundie 1974). Food supplementation studies (e.g., Mason 1976; Mesa et al 2007) have shown a clear relationship between food abundance and the growth rate and biomass yield of juveniles in streams. Therefore, herbicide applications that kill or otherwise reduce the abundance of macrophytes and macroinvertebrates in streams can also reduce the energetic efficiency for growth in salmonids. Less food can also induce density-dependent effects, such as increased competition among foragers as prey resources are reduced (Ricker 1976). These considerations are important because juvenile growth is a critical determinant of freshwater and marine survival (Higgs et al. 1995). A study on size-selective mortality in Chinook salmon from the Snake River (Zabel and Williams 2002) found that naturally reared wild fish did not return to spawn if they were below a certain size threshold when they migrated to the ocean. There are two primary reasons mortality is higher among smaller salmonids. First, fish that have a slower rate of growth suffer size-selective predation during their first year in the marine environment (Parker 1971;

Healey 1982; Holtby et al. 1990). Growth-related mortality occurs late in the first marine year and may determine, in part, the strength of the year class (Beamish and Mahnken 2001). Second, salmon that grow more slowly may be more vulnerable to starvation or exhaustion (Sogard 1997).

The primary indirect, adverse effects resulting from the proposed action are expected to be of varying duration (weeks to years). Degraded water quality, reflected by primary and secondary productivity loss, from herbicide applications will last a maximum of a few weeks. Recovery of algae and aquatic macrophytes can take weeks to months. Riparian disturbance and disturbed soils resulting from accessing work sites will stabilize and begin to revegetate in one year. However, full functionality of riparian vegetation could take years.

Effects on Critical Habitat

During consultation, NMFS considered each of several mechanisms for salmonid exposure to the effects of the proposed action. Each of those is described in detail in the "Effects on ESA-Listed Species" section, above. In turn, where the possibility of exposure is reasonably certain, NMFS considered whether exposed fish would respond to exposure. Through these sequential assessments, the consultation focused down on herbicide applications as the only significant effects mechanism bearing on ESA-listed fish. The same is true for the effects of the action on critical habitat and the review of effects mechanisms other than herbicide application is therefore not repeated here.

The proposed invasive plant treatment areas are scattered throughout the GPNF and CRGNSA and are of varying size. Potential effects of invasive plant treatment on designated critical habitat will vary at each location depending on the size of the treatment area, treatment type, the chemicals used, method of application, rate of application, distance from water, and vegetative characteristics of the treatment areas. Where chemicals reach the water and achieve effect threshold concentrations, they will change the functional condition of the water quality elements of PCEs, and the ability of those places to meet the ecological needs of the species for which critical habitat is designated. These changes include changed water quality and diminished food availability.

The PCEs in the action area are: 1) freshwater spawning, 2) freshwater rearing, and 3) freshwater migration corridors. For the spawning PCE, water quality meeting the ecological needs of salmon and steelhead must support spawning, incubation, and larval development. For the rearing sites, there must be water quality and forage to support juvenile development. Finally, migration corridors, in addition to supporting free and protected movement of fish, must also have water quality supporting juvenile development as they progress downstream toward their transitional estuarine life history. The proposed action is likely to cause changes in individual PCEs in the action area by the introduction of herbicides and their agents into critical habitat that will influence to some degree, the conservation role of that critical habitat. Specifically, the proposed action will cause exposure to aquatic invertebrates, algae, and aquatic macrophytes, and responses in algae, and aquatic macrophytes.

Benthic algae are important primary producers in aquatic habitats and are thought to be the principal source of energy in many mid-sized streams (Minshall 1978; Vannote et al. 1980; Murphy 1998). Herbicides cause shifts in the composition of benthic algal communities at concentrations as low as in the low parts per billion. Herbicides can elicit significant effects on aquatic microorganisms at concentrations that may occur with normal usage under the label instructions. In most cases, the sensitivities of algal species to herbicide formulations and their response to herbicide formulations are not known. However, human activities that modify the physical or chemical characteristics of streams can change the trophic system that ultimately reduces salmonid productivity (Bisson and Bilby 1998). Consequently, herbicides have the potential to affect salmonid productivity through their effects on the biotic community.

The results of HQ threshold exceedances, as a measure of prey productivity, are presented in Tables 16 and 17 below. Aquatic invertebrates are not listed as no HQ threshold exceedances were observed (See Appendix C).

Herbicide Applications—PCE Exposure from Riparian Application. This section addresses exposure risks to algae and aquatic macrophytes in both small streams and the margins of larger streams from runoff and percolation resulting from herbicide application in riparian areas. The analysis is based on the small stream scenario used in the risk assessments performed by SERA for the FS, and provides a higher risk exposure scenario. The exposure scenario is for a 10 acre herbicide application adjacent to a small stream (base flow of 1.8 cfs). The exposure analysis assumes pure soil types. In reality, soils are mixtures of components. Therefore, the WCR values for the pure soil types may underestimate exposure for some soil types on the GPNF and CRGNSA.

Table 16. Summary of potential algae and aquatic macrophyte hazard quotient (HQ) values in adjacent streams based on typical and maximum herbicide application rates in riparian areas.

		Riparian Application											
		Typical Application Rate						Maximum Application Rate					
		Clay		Loam		Sand		Clay		Loam		Sand	
Herbicide	Rainfall Rate	Algae HQ Value	Macrophyte HQ Value	Algae HQ Value	Macrophyte HQ Value	Algae HQ Value	Macrophyte HQ Value	Algae HQ Value	Macrophyte HQ Value	Algae HQ Value	Macrophyte HQ Value	Algae HQ Value	Macrophyte HQ Value
Chlorsulfuron	15 inches	0.07	1.0	0.0000	0.0000	0.0000	0.0000	0.3	4.5	0.0000	0.0000	0.0000	0.0001
	50 inches	0.6	9.0	0.002	0.03	0.07	1.0	2.8	40	0.01	0.1	0.3	4.6
	100 inches	1.1	16	0.01	0.2	0.2	2.7	5.0	71	0.07	0.9	0.9	12
Clopyralid	15 inches	0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0000	0.0000
	50 inches	0.0005	0.0005	0.0004	0.0004	0.0009	0.0009	0.0008	0.0008	0.0005	0.0005	0.001	0.001
	100 inches	0.0005	0.0005	0.001	0.001	0.002	0.002	0.0008	0.0008	0.002	0.002	0.003	0.003
Glyphosate	15 inches	0.001	0.0000	0.002	0.0001	0.006	0.0003	0.004	0.0002	0.009	0.0004	0.03	0.001
	50 inches	0.02	0.0007	0.03	0.001	0.05	0.002	0.07	0.003	0.1	0.005	0.2	0.009
	100 inches	0.05	0.002	0.07	0.003	0.1	0.006	0.2	0.009	0.3	0.01	0.5	0.02
Imazapic	15 inches	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	50 inches	0.001	0.008	0.0000	0.0001	0.0002	0.001	0.002	0.02	0.0000	0.0002	0.0003	0.003
	100 inches	0.002	0.02	0.0002	0.001	0.0004	0.004	0.004	0.03	0.0003	0.003	0.0008	0.007
Imazapyr	15 inches	0.0001	0.001	0.0000	0.0000	0.0000	0.0000	0.0004	0.004	0.0000	0.0000	0.0000	0.0001
	50 inches	0.001	0.01	0.0000	0.0001	0.0004	0.003	0.005	0.04	0.0000	0.0002	0.001	0.01
	100 inches	0.003	0.03	0.0002	0.002	0.0007	0.006	0.01	0.08	0.0006	0.005	0.002	0.02
Metsulfuron	15 inches	0.0000	0.02	0.0000	0.0000	0.0000	0.002	0.0000	0.09	0.0000	0.0000	0.0000	0.01
	50 inches	0.0000	0.2	0.0000	0.007	0.0000	0.04	0.0002	0.8	0.0000	0.04	0.0001	0.2
	100 inches	0.0001	0.3	0.0000	0.02	0.0000	0.08	0.0004	1.4	0.0000	0.08	0.0001	0.3
Picloram	15 inches	0.004	0.0000	0.0000	0.0000	0.007	0.0000	0.01	0.0001	0.0000	0.0000	0.02	0.0001
	50 inches	0.04	0.0002	0.004	0.0000	0.02	0.0001	0.1	0.0006	0.01	0.0001	0.05	0.0003
	100 inches	0.07	0.0004	0.006	0.0000	0.03	0.0001	0.2	0.001	0.02	0.0001	0.07	0.0004
Sethoxydim	15 inches	0.006	0.006	0.002	0.002	0.02	0.02	0.008	0.008	0.003	0.003	0.04	0.04
	50 inches	0.07	0.07	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
	100 inches	0.2	0.2	0.4	0.4	0.2	0.2	0.3	0.3	0.6	0.6	0.3	0.3
Sulfometuron	15 inches	0.0005	0.0003	0.0000	0.0000	0.0000	0.0000	0.006	0.004	0.0000	0.0000	0.0000	0.0000
	50 inches	0.005	0.003	0.0000	0.0000	0.0008	0.0005	0.07	0.04	0.0001	0.0001	0.0000	0.006
	100 inches	0.01	0.007	0.0003	0.0002	0.002	0.001	0.1	0.08	0.004	0.002	0.02	0.01
Triclopyr	15 inches	0.003	0.002	0.003	0.002	0.003	0.002	0.03	0.02	0.03	0.02	0.03	0.02
	50 inches	0.02	0.01	0.02	0.01	0.009	0.006	0.2	0.1	0.2	0.1	0.09	0.06
	100 inches	0.04	0.03	0.03	0.02	0.01	0.01	0.4	0.3	0.3	0.2	0.1	0.1

Shaded cells represent HQ values greater than 1.

Chlorsulfuron HQ exceedances were observed for aquatic macrophytes at rainfall rates between 15 and 100 inches per year. The HQ exceedances occurred at both typical and maximum chlorsulfuron application rates, with clay soils producing the highest exeeedances, and sandy soils producing lower HQ exceedances. Ash soils are the predominant soil types in the action area. With permeability similarly to sand, and clay soils, ash soils have the potential to produce the greatest exceedances at both typical and maximum application rates.

The HQ values for algae were exceeded at rainfall rates ranging between 50 and 100 inches per year. Clay soils appeared to produce the highest exceedances. At typical application rates, the HQ value for algae exhibited a minor exceedance. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall of 50 to 100 inches per year, is likely to adversely affect critical habitat by adversely affecting aquatic macrophyte and algal production when occurring on soils with both high and low permeability.

Given the wide range of HQ values observed among soil types at a range of rainfall rates, soil type is clearly a major driver of exposure risk for chlorsulfuron, with low and high permeability soils markedly increasing exposure levels. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall of 50 to 100 inches per year, is likely to adversely affect critical habitat by adversely affecting aquatic macrophytes. Application on soils with low and high infiltration rates will have a substantially higher risk of resulting in adverse effects. The PDC H7 which requires avoidance of the use of chlorsulfuron on soils with high clay content will partially minimize adverse effects on algae and aquatic macrophyte production.

A metsulfuron HQ exceedance for aquatic macrophytes occurred at the maximum application rate on clay soils at rainfall rates of 100 inches per year. No exceedances were observed on any soils at the typical application rate or on loam or sandy soil at the maximum application rate. Application of metsulfuron adjacent to stream channels on soils with low permeability at application rates approaching the maximum is likely to adversely affect critical habitat by adversely affecting aquatic macrophytes.

Herbicide Application—Exposure from Treatment of Dry Intermittent Channels and Ditches. The section below discusses the exposure risks to critical habitat from herbicide treatment in dry intermittent channels and ditches and describes those herbicides which can be hand selected and spot sprayed within ditches and at bankfull levels. It also identifies the primary factors affecting exposure risk. Columns 2 through 5 of Table 17 summarize the HQ exceedances at both typical and maximum application rates for algae and aquatic macrophytes.

When chlorsulfuron is applied to ditches and dry, intermittent streams, at both typical and maximum rates, it exceeds HQ values for both algae and aquatic macrophytes. Chlorsulfuron ranges from an HQ exceedance of 4.9 for algae at the typical rate, to an HQ exceedance of 311 for aquatic macrophytes at maximum application rate.

Imazapic exhibited HQ exceedances for both algae and aquatic macrophytes at typical and maximum application rates (HQ range of 1.7 to 3.3 for algae and 14 to 27 for aquatic macrophytes).

Imazapyr HQ exceedances were identified for both algae and aquatic macrophytes when applied to ditches and dry channels under typical and maximum application rates (HQ value ranges of 2.0 to 6.5 for algae and 17 to 57 for aquatic macrophytes).

Metsulfuron can potentially be present in concentrations highly toxic to aquatic macrophytes at both typical and maximum application rates (HQ value range of 130 to 652).

Sethoxydim HQ exceedances are minimal. However, HQ exceedances do occur for both algae and aquatic macrophytes at typical and maximum application rates.

Sulfometuron HQ exceedances occurred for both algae and aquatic macrophytes when applied at typical and maximum application rates (HQ values ranging from 5.7 to 72 for algae and 3.5 to 44 for aquatic macrophytes).

Triclopyr application appears to exceed the effects threshold values only when applied at the maximum application rate. Both algae and aquatic macrophyte HQ values were minimally exceeded (HQ value 1.5 for algae, and 1.0 for aquatic macrophytes).

Table 17. Summary of potential algae and aquatic macrophyte hazard quotient (HQ) values based on typical and maximum herbicide application rates in ditches/dry channels and applications within occupied streams.

	Ditches and Dry Channels				Instream Application							
	Algae		Aquatic Macrophytes		Typical Application Rate				Maximum Application Rate			
Herbicide	Typ. Rate	Max. Rate	Typ. Rate	Max. Rate	HQ value for 1' deep water - instream rinse		HQ value for 1' deep water instream overspray		HQ value for 1' deep water - instream rinse		HQ value for 1' deep water - instream overspray	
	HQ Value	HQ Value	HQ Value	HQ Value	Algae	Aquatic Macrophytes	Algae	Aquatic Macrophytes	Algae	Aquatic Macrophytes	Algae	Aquatic Macrophytes
Chlorsulfuron	4.9	22	70	311								
Clopyralid	0.04	0.1	0.0	0.1								
Glyphosate	0.2	0.9	0.0	0.0	0.1	0.006	0.09	0.004	0.5	0.02	0.4	0.02
Imazapic	1.7	3.3	14	27								
Imazapyr	2.0	6.5	17	57	0.6	4.9	0.2	1.8	1.9	16	0.7	6.0
Metsulfuron	0.03	0.2	130	652								
Picloram	0.32	0.9	0.002	0.005								
Sethoxydim	1.0	1.6	1.0	1.6								
Sulfometuron	5.7	72	3.5	44								
Triclopyr	0.1	1.5	0.1	1.0	0.04	0.03	0.02	0.01	0.4	0.3	0.2	0.1

Shaded cells represent HQ values greater than 1.

Herbicide Application—Exposure from Treatment in Perennial Streams. Table 17 above illustrates the potential HQ values associated with the application of glyphosate, imazapyr and triclopyr within the channel for treatment of emergent vegetation. Below bankfull and gravel bar application of imazapyr can have direct lethal effects on aquatic macrophytes at both typical and maximum application rates in 1 foot of water after rainfall rinse from emergent vegetation, (the amount of glyphosate amount available for dissolution (62.5 percent of the amount applied) is based on assumptions of a foliar wash-off fraction plus overspray (SERA 2003a), the imazapyr amount assumes a 0.9 foliar wash-off fraction (SERA 1999) and the triclopyr amount assumes a 0.95 foliar wash-off fraction (SERA 2003b)), and 1 foot of water resulting from overspray of emergent vegetation (an assumed 25 percent overspray rate).

The only herbicide that exhibited HQ value exceedances resulting from direct application of herbicides to emergent plants within perennial streams was imazapyr. Imazapyr appears to pose a risk to aquatic macrophytes when applied at both the typical and maximum application rates. In addition, it did exhibit HQ exceedances for both foliar wash-off and overspray. The HQ exceedance for foliar wash-off for both typical and maximum application rates ranged from 4.9 to 16. In addition, imazapyr exhibits HQ exceedances for algae from foliar wash-off when applied at the maximum application rate.

Response of the Primary Constituent Elements of Critical Habitat to Exposure. The following critical habitat analysis summarizes the effects of the proposed action on critical habitat PCEs, and evaluates how changes in PCEs affect conservation value at the watershed scale.

Freshwater Spawning Sites - Water Quality. Short-term adverse effects on water quality are likely to occur when near or in-water invasive plant treatment occurs. Increased turbidity resulting from treatment will last for a few hours to a maximum of a few weeks. Minor inputs of chemical herbicides as described above will degrade water quality for a period of hours to days. Impacts to freshwater spawning sites will be minimized through not conducting treatments during spawning periods. In the long-term, the removal of invasive plants is designed to improve water quality. Planting riparian areas creates shade and thus reduces summer stream temperatures.

Freshwater Rearing Sites - Water Quality. Water quality will be affected as described for spawning sites, above.

Freshwater Rearing Sites—Forage. Reductions in primary production are likely to occur as a result of increased herbicides and fine sediment generated by invasive plant treatment. Exposure to herbicides is predicted to occur from riparian applications in areas with average rainfall levels from 50 to 100 inches per year causing exceedances of the chlorsulfuron HQ value. In addition, application of herbicides to ditches and dry channels is predicted to create exposure of seven of the 10 proposed herbicides at levels that exceed the HQ values for algae and aquatic macrophytes. Lastly, below bankfull emergent plant treatment is predicted to cause exceedances of the imazapyr HQ value at both typical and maximum application rates. While these effects are not likely to extend more than a few hundred feet below treatment sites, and these areas are likely to be recolonized by primary producers within a few months, the short-term could pose a significant lack of forage for CC, LCRC, LCC, and especially LCS as they remain the longest in the watersheds. In the long-term, all of the sites that have had treatment are likely to exhibit improved riparian function, reduced inputs of fine sediments, and enhanced establishment of healthy riparian plant communities resulting in increased terrestrial and aquatic forage.

Freshwater Migration Corridors - Water Quality. Water quality will be affected as described above.

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). NMFS summarizes the cumulative effects in terms of certain future and ongoing, but presently incomplete actions in the action area or that might affect conditions there.

Watershed conditions in the action area will continue to be influenced by a variety of land-uses including recreation, agriculture and livestock grazing, forest management, building and conversion, and attendant road construction, use, and maintenance, and the results of recovery plan implementation. Detailed information on these activities and their influence in the action area are not specifically available. However, information on the entire Lower Columbia basin can be found at: http://www.lcfrb.gen.wa.us/recovery%20planning%20overview.htm. Based on patterns of growth and land use around the Columbia Basin, current levels of these uses are likely to persist or grow. The environmental results of land use changes at large include water quality issues such as pollutants and pesticides, turbidity, temperature increase, changed hydrology, increased sediment deposition, as well as habitat access issues due to physical barriers.

To deal with the issue of invasive species in the region, the GPNF and CRGNSA expect local county noxious weed boards to continue to focus on priority weeds that pose risks to areas, such as riparian corridors and recreational lakes. Knotweed is a common priority species. It is expected that the counties will work with GPNF and CRGNSA cooperatively to control invasive plants. If agreements are established with counties for noxious weed control outside of the boundaries of the GPNF and CRGNSA, FS standards from the documents described in the Background section of this Opinion will be incorporated into those agreements.

Cities, Counties, and Washington State all have ongoing weed treatment programs operating in the region that can affect conditions in the action area. While programs for the prevention of off-site or off-target herbicide spread are not known, this Opinion presumes that the programs do not have prevention measures similar to the GPNF and CRGNSA. Weeds are treated along road rights-of-way annually by city, state, and county transportation departments, sometimes several times a year. Any herbicide contamination that occurs from the proposed GPNF and CRGNSA action could potentially combine with contaminants from other non-Federal activities, and contribute to formation of chemical mixtures or concentrations that could kill or harm listed steelhead or salmon. Similarly, chemical mixtures or increased chemical concentrations could adversely affect designated critical habitat. Fish stressed by elevated sediment and temperatures and limited habitat due to lack of accessibility are more likely to be susceptible to toxic effects of herbicides. While the mechanisms for cumulative effects are clear, the actual effects cannot be quantified.

Synthesis

Adverse effects on listed fish, and to the algal and aquatic macrophyte critical habitat elements, are likely to occur from the use of herbicides at known and EDRR sites (Table 18). The magnitude and frequency of adverse effects on listed fish will vary depending upon rate of application, application timing relative to fish presence and life history stage, and application timing relative to periods of rainfall. However, only two herbicides, (glyphosate and triclopyr) have been identified as likely to cause adverse effects on listed fish. The magnitude and frequency of adverse effects on aquatic macrophytes and algae will be high for some herbicides: primarily chlorsulfuron when applied at riparian treatment sites with sand or ash and clay soils; chlorsulfuron, imazapic, imazapyr, metsulfuron, sulfometuron and triclopyr when applied in ditches and dry channels; and imazapyr when applied at below bankfull treatment sites.

Table 18. Herbicide HQ exceedances for fish and critical habitat representatives according to application method at known and EDRR sites (synthesis from Tables 12, 13, 16 and 17).

	Riparian application	Application within ditches and dry channels	Application below bankfull for emergent vegetation
Salmon and steelhead	Glyphosate Triclopyr	Glyphosate Triclopyr	Glyphosate Triclopyr
Critical habitat features	Chlorsulfuron Metsulfuron	Chlorsulfuron Imazapic Imazapyr Metsulfuron Sethoxydim Sulfometuron Triclopyr	Imazapyr

Direct adverse effects on individual listed fish are likely to result from glyphosate and triclopyr applications 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 (diminished olfactory capacity) that can increase predation risk from short-term exposures to low (*i.e.*, single digit) HQ exceedances, are reasonably likely to occur. Indirect adverse effects on listed fish from loss of primary production are also reasonably likely to occur. Assessments of effects on specific populations and critical habitat are documented below.

When treatments occur that utilize two or more herbicides in close proximity, exposures to mixtures may follow. Simultaneous exposure to other herbicides may increase the level of adverse effects from glyphosate and triclopyr exposure. Additional adverse effects are most likely to manifest as an additive, and non-synergistic response in fish. However, the cumulative HQ values for the other eight herbicides under realistic co-exposure scenarios are not likely to exceed that for below bankfull applications of glyphosate and triclopyr. In other words, defacto mixtures are not likely to substantially increase effects likely from glyphosate and triclopyr exposure alone.

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 macrophtye production may cause intermittent reductions in availability of forage for rearing juvenile salmonids. Juvenile salmonids that receive less food over time have lower body condition and smaller size at smoltification.

In general, most instream exposures of herbicides are short-lived, discreet events associated with overspray, rinse, or runoff events. Conditions such as diminished water quality are likely to return to normal within a few hours to a few days, once the source is eliminated. While water quality concentrations can shift quickly, loss of forage can take a few months to recover. Long-term changes in habitat features are possible as a result of changes in riparian vegetation. If there is a high frequency of repeat treatments of those herbicides which exhibited high HQ values the effects are poorly understood and could be subtle. Herbicide use may affect salmonid habitat detrimentally through the short-term loss of primary production of algae and aquatic macrophytes, and beneficially through long-term restoration where natural plant communities and disturbance regimes have been altered by weeds. Because the proposed action will ultimately result in the restoration of degraded habitat, long-term adverse alteration of habitat is not anticipated to occur.

Adverse effects on aquatic invertebrates are not likely to occur from herbicide exposure under any of the treatment categories however, adverse effects on algae and aquatic macrophytes are likely to result from herbicide application in riparian, ditch/intermittent channel, and below bankfull applications, but not always from the same herbicides. Adverse effects on algae and aquatic macrophytes that translate to significant indirect adverse effects (via alteration in food supply, cover, etc.) to listed fish may result from brief exposures of aquatic macrophytes from application to ditches with chlorsulfuron, imazapic, imazapyr, metsulfuron, sethosydim, sulfometuron, and triclopyr. In these cases the aquatic macrophyte HQ values for ditch effluent at stream channel confluences can potentially reach levels that are likely to translate to significant indirect adverse effects on listed fish. Due to roads acting as the primary seed dispersion corridors, heavy invasive plant infestation of natural intermittent channels is less likely to occur than in ditches. Thus, intensive herbicide application within intermittent channels is also less likely to occur.

Table 19. Synthesis of population trend information and effects of the action for known and future site treatment on LCS, MCS, LCC, LCRC, and CC.

ESA Listed Species that spawn/rear in action area	VSP Productivity Lambda (short-term)	Ditch Analogy for Known Treatment Sites ** (GPNF and CRGNSA)			EDRR*** (GPNF and CRGNSA) (Appendix Table B7)
		Total stream crossings in treatment areas	Total stream crossings in treatment area located within 660 feet of LCS streams	Total stream crossings in treatment areas located directly over LCS streams	Maximum percent of below bankfull acres treated annually per fifth field
LCS	0.96	1526 (GPNF)	109 (GPNF)	25 (GPNF)	2.32% (GPNF)
MCS	0.94				
LCC	0.99				
LCRC	*	27 (CRGNSA)	22 (CRGNSA)	NA (CRGNSA)	28.99%**** (CRGNSA)
CC	0.92 - 1.23				

* All of the Washington LCRC fish contain hatchery spawners making the determination of extinction risk difficult.
** Ditch analogy: glyphosate and triclopyr are likely to exceed the fish HQ threshold when applied within 660 ft of listed species occupied streams. Chlorsulfuron, imazapic, imazapyr, metsulfuron, sethoxydim, sulfometuron, and triclopyr are likely to exceed the algae and aquatic macrophyte HQ thresholds when applied within 660 feet of streams
*** Data compiled from Appendix B, Tables B3, B7, B9, and B13, and based on PDC H14 which allows for no more than seven acres within a sixth field sub-watershed in any given year to be treated. Sixth field values were summed to arrive at fifh field values. Glyphosate and triclopyr are likely to exceed the fish HQ threshold when applied to emergent vegetation below bankfull. Imazapyr is likely to exceed the algae and aquatic macrophyte HQ thresholds when applied to emergent vegetation below bankfull.
**** Value is inflated due to low instream acres on many watersheds on the CRGNSA

Three things influence the adverse effects on listed species and designated critical habitat, from treatment of known and EDRR program sites. The first is timing of application relative to rainfall, and species' life history stage. The second is size of treatment areas and number of potential road crossings relative to size of entire watershed and distribution of species. The third is the amount of treatment of known and future emergent vegetation with glyphosate and triclopyr relative to the listed species' status, value of critical habitat, and the environmental baseline condition.

Timing of Treatments: In some circumstances, herbicides are likely to wash into streams from rainfall occurring during or shortly after herbicides are applied along road ditches or on low permeability soils. Rainstorms are likely to occur within the watersheds containing listed salmonids. In such instances, adverse effects on fish could occur particularly in small tributary streams where the herbicide-laden flows would not be readily diluted. On certain occasions when rainfall occurs during or soon after herbicide application, listed fish are likely to be exposed to herbicide concentrations leading to the occurrence of sublethal effects. Outright mortality of fish from herbicide exposure as a result of the proposed action is unlikely. In some circumstances, isolated reductions of primary productivity could occur. While it is reasonably certain that individual listed species in the action area could express impaired normal behavioral patterns, be injured, or suffer ecological death, these outcomes will be limited because exposures will be too intermittent, based on the GPNF and CRGNSA's proposed action and the incorporated PDC minimization measures. As a result, these outcomes are not likely to produce an observable change in the abundance, distribution, diversity, or productivity of these species at either the population or species level. The isolated cases of reduction of the freshwater rearing forage PCE is also not likely to decrease the conservation value of critical habitat, nor detrimentally affect the productivity of the species' freshwater life cycle.

Size, Type, and Location of Treatment Areas: According to the FS, the size of known treatment areas throughout the action area overestimates the size of the actual infestations or the size of the sites that will be treated (Perez pers. comm. 2007). The delineation of treatment area was employed by the FS as a measure of convenience for incorporation into a GIS database. On the ground the infestations are patchy and scattered within each of the large treatment area polygons. In addition, treatment priorities will determine when specific plants within specific sites may be treated. While some known treatment sites are adjacent to rearing and migration areas for SBS, SRS, SFC, SSC, UCS, and UCSC, risks of exposure are minimal due to those species' low nearshore dependence. Some known treatment sites, however, are located immediately adjacent to LCS, MCS, LCC, LCRC, or CC spawning or rearing grounds. In addition, one site in the CRGNSA contains emergent plants which will require the application of herbicides below bankfull.

Potential adverse effects to individual listed fish from exposure to herbicides from road ditch stream crossings or below bankfull treatment could also occur. Within known treatment sites on the GPNF the number of stream crossings directly over LCS bearing streams in any fifth-field watershed is 25 and the total within the forest is 1526 (Appendix, Table B3). The predicted EDRR program number of future stream crossings directly over LCS streams is 95. Some of the known ditch treatments within the action area would occur within 660 feet of a LCS stream and along the entire 660 foot length within the same spray season (Tables 19). In addition, the number of predicted EDRR program stream crossings within 660 feet of an LCS stream is 416 (Table B8).

Within the CRGNSA's known treatment sites the total number of stream crossings is 27 (Appendix, Table B9). The predicted EDRR program number of future stream crossings is 90. Some of the known ditch treatments within the action area would occur within 660 feet of an LCS or MCS stream and along the entire 660 foot length within the same spray season (Tables 19). In addition, the number of predicted EDRR program stream crossings within 660 feet of an LCS stream is 72 (Table B14).

While it is reasonably certain that individual LCS, MCS, LCC, LCRC, or CC could express impaired normal behavioral patterns, be injured, or suffer ecological death, these outcomes will be limited because exposures will be intermittent, based on the GPNF and CRGNSA's proposed action and its incorporated PDC minimization measures. As a result, these outcomes are not likely to produce an observable change in the abundance, distribution, diversity, or productivity of these species at either the population or species level.

Amount of Treated Known and Future Emergent Vegetation: The amount of treatment of known and future emergent vegetation has the potential to degrade freshwater rearing conditions for LCS, MCR, LCC, LCRC, or CC's forage PCE and to directly affect the already low productivity of these species. Specifically, treatment on two known sites on the CRGNSA could expose spawning and rearing LCS and LCRC to adverse effects from direct exposure to glyphosate and triclopyr through the below bankfull treatment of emergent plants. Under the EDRR program, as seen in Table 19, the GPNF could experience up to 2.32 percent. The percent below bankfull treatments that the CRGNSA could experience is unclear. However, the average percent of a few of the watersheds could range from five to 30 (Table B13). Based on the findings in Table 17, reductions in the production of algae and aquatic macrophytes could be elicited through the treatment of emergent vegetation with imazapyr at typical and maximum rates. The ability of the LCS, MCS, LCC, LCRC, or CC populations to overcome these effects on the forage PCE is uncertain. If the sites are scattered across the watersheds, then the intensity of the adverse effects will not likely reduce the conservation value of critical habitats at the watershed scale. If an emergent vegetation site is found that equates to the full extent of the PDC H14 of no more treatment than seven acres in any sixth field subwatershed annually the function of the PCEs at the local level could be reduced. However, the spatial and temporal prescription of the program prevents the aggregation of effects on PCEs on the local level from rising to a level that would reduce the conservation value of the watersheds. While it is reasonably certain that individual LCS, MCS, LCC, LCRC, or CC will express impaired normal behavioral patterns, be injured, or suffer ecological death, these outcomes will be limited because exposures will be too intermittent, based on the GPNF and CRGNSA's proposed action and its incorporated PDC minimization measures. As a result, these outcomes are not likely to produce an observable change in the abundance, distribution, diversity, or productivity of these species at either the population or species level.

Throughout the action area, the proposed EDRR program will diminish chemical habitat quality through the use below bankfull of glyphosate and triclopyr. Treatment of emergent vegetation, at both typical and maximum herbicide rates, could occur along margins of any stream where juvenile LCS, or MCS, are rearing. Given their characteristic of spending one to four years in freshwater prior to emigrating to the sea, and their strong use of side-channel habitat, the likelihood of exposure is high. The cumulative effects of other pesticide use downstream of the GPNF enhances the exposure risks of both juvenile and adult LCS, or MCS, and brings in the factor of pesticide mixtures, further adding to the potential sublethal effects. While it is reasonably certain that individual LCS, or MCS will express impaired normal behavioral patterns, be injured, or suffer ecological death, these outcomes will be limited because exposures will be too intermittent, based on the GPNF's approach to treatment prioritization. As a result, these outcomes are not likely to produce an observable change in the abundance, distribution, diversity, or productivity of these species at either the population or species level.

Combining the species status and the environmental baseline in the action area with the percentage of known treatment area within 50 meters of occupied streams, the number of treatment sites below bankfull, the number of direct crossings over fish bearing waters, the number of ditches greater than or equal to 660 feet, and future predicted EDRR program sites, it becomes reasonable to conclude that while the proposed action is reasonably certain to modify habitat for individual fish that would change their behavior, or injure or kill them, the effects would not affect characteristics of population viability. As such, the proposed action would not adversely influence extant risks for the long term survival of affected ESUs and DPSs.

Conclusion

After reviewing the best scientific and commercial data available on status of the affected species and their designated critical habitats, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, NMFS concludes that the action as proposed is not likely to jeopardize the continued existence of LCS, MCS, LCC, LCRC, CC, SBS, SRS, SFC, SSC, UCS, or UCSC. A small number of fish are likely to suffer impaired normal behavior, or be injured or suffer ecological death by the proposed action during treatment of the known and EDRR program sites. However, due to dispersed use of chemicals, manual, mechanical and restoration activities, caps on types and amounts of treatments in any given watershed and in any given year, and many safeguards designed to prevent or minimize introduction of herbicides into streams, this action will not rise to the level of jeopardizing the continued existence or hindering the ability to achieve recovery of the LCS, MCS, LCC, CC, SBS, SRS, SFC, SSC, UCS, or UCSC species.

Similarly, limited freshwater rearing and spawning areas of designated critical habitat will be adversely affected. However, NMFS also determines that the action is not likely to result in the adverse modification or destruction of designated critical habitat of LCS, MCS, LCC, LCRC, CC, SBS, SRS, SFC, SSC, UCS, or UCSC. These determinations are based principally on a likelihood of water contamination from herbicides resulting in adverse effects that are likely to be limited in area, duration, and in severity.

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 FS:

1. A number of recovery plans are under development:

The Lower Chinook recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Willamette-Lower-Columbia/Index.cfm.

The Upper Columbia River chinook is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Upper-Columbia/Index.cfm.

The Snake River spring/summer chinook is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Snake/Index.cfm

The Snake River fall chinook is ongoing and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Snake/Index.cfm.

The Columbia River chum salmon is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Willamette-Lower-Columbia/Index.cfm.

The Lower Columbia River coho is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Willamette-Lower-Columbia/Index.cfm.

The Snake River sockeye is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Snake/Index.cfm.

The Lower Columbia River steelhead is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Willamette-Lower-Columbia/Index.cfm.

The Middle Columbia River steelhead is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Mid-Columbia/Index.cfm.

The Upper Columbia River steelhead is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Upper-Columbia/Index.cfm.

The Snake River steelhead is ongoing, and recovery planning status can be reviewed online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Snake/Index.cfm.

NMFS encourages the FS to consider the recommended actions and prioritization plans found in the final recovery plans when planning invasive plant treatment projects on the GPNF and CRGNSA.

2. The GPNF and CRGNSA should use herbicides with the least toxicity to listed fish and other non-target organisms whenever possible.

3. The GPNF and CRGNSA should investigate the utility of alternative forms of weed control that do not involve the use of chemicals toxic to aquatic organisms.

4. The applicator should only use surfactants or adjuvants in riparian areas where the effects of the ingredients have been tested on salmonids and have been found to be of low toxicity and the products do not contain any ingredients on EPA's List 1 or 2.

5. The GPNF and CRGNSA should minimize the use of combining herbicides where practicable.

Please notify NMFS if these recommendations are carried out 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

To ensure that the effects of the proposed action remain within the scope of those analyzed in the Opinion over the duration of the proposed action, reinitiation of formal consultation is required after five years. In addition, reinitiation of formal consultation is required and shall be requested by the GPNF, CRGNSA, or by NMFS where discretionary Federal involvement or control over the action has been retained or is authorized by law and if: (1) the amount or extent of taking specified in the ITS is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that has an effect to the listed species or critical habitat that was not considered in the Opinion; (4) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR. 402.16); (5) the timing and finding of the Technical Review Panel's final review warrants it, or (6) reintroduction of listed species occurs into habitat currently unoccupied within the action area. If reinitiation of consultation appears warranted due to one or more of the above circumstances, contact the Washington State Habitat Office of NMFS and refer to the NMFS Tracking Number 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 (July 10, 2000, 65 FR 42422). Among other things, an action that harasses, wounds, or kills an individual of an ESA-listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 CFR 222.102). Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

Amount or Extent of Take

Recent and historical surveys indicate that listed species occur in the action area, in places where they will be exposed to the effects of the action. Some exposed fish will respond to these effects by changing normal behaviors, in some cases to their detriment, by injury or by dying through sublethal effects. These results are not the purpose of the proposed action. Therefore, incidental take of those animals is reasonably certain to occur.

Chemicals are most likely to reach streams when they are applied below bankfull, or to riparian areas, dry ditches and intermittent streams when immediately followed by rainfall. Consequently, the spatial limitations on treatment of the known and EDRR program sites on an annual basis represent the absolute maximal area of chemical treatment-based habitat modification that could rise to the level of harm of listed fish. As described below, there is no practical alternative to using this spatial measure of take given that the precise treatment needs of and site-specific features affecting individual sites, as well as weather conditions, cannot be accurately predicted in advance.

Despite the use of best scientific and commercial data available, NMFS cannot quantify the specific number of fish or incubating eggs or fry that may be taken by the proposed action. The number of animals exposed to chemical concentrations sufficient to change their behavior, or injure or kill them, depends on several variables. These variables include the specific times and locations that invasive plant treatments will occur, rainfall, wind, humidity, and proximity of treatment sites to individual fish or redds. Additionally, the number of fish or redds that may be exposed cannot be estimated because response would greatly vary, from no response to sublethal changes in normal behavior, to injury, or ecological death.

The difficulty of estimating take as a number of affected fish was recognized early during consultation. This recognition is acknowledged in the framework of the proposed action itself. The action incorporates safeguards to ensure that program activities are carried out in a manner that minimizes the negative effects of invasive plant treatments on listed species by restricting chemical use and treatment methods to those minimally necessary to achieve program objectives and by strictly limiting the extent of acreage that may be treated within riparian buffer areas and below bankfull. Therefore, the likelihood of incidental take is reduced or avoided as a threshold matter. Nevertheless, because some level of incidental take may occur, NMFS must estimate the extent of that take so as to frame the limits of the take exemption provided in this Incidental Take Statement and set a threshold which, if exceeded, would be a basis for reinitiating consultation.

To derive that extent, NMFS assessed the extent of treatment sites contemplated by the proposed action. As such the extent equates to the 112 known sites on the GPNF and CRGNSA, and the annual extent of EDRR program treatment sites. This represents a coarse (and likely overestimated) extent of habitat modified by the proposed action. The extent of incidental take exempted in this Incidental Take Statement is the extent of habitat modified:

1. for known sites the acreage where herbicides are proposed to be applied to riparian area, ditches and dry channels, and below bankfull for emergent vegetation management,

2. above bankfull, within the aquatic influence zone, up to 10 acres along any 1.5 mile of stream reach within a sixth field subwatershed in any given year, and

3. below bankfull up to seven total acres within each sixth field sub-watershed in any given year.

Based on the existence of 51 sixth field watersheds on the GPNF, the maximum annual extent of habitat that could be modified by EDRR program treatments in the action area is 460 acres (2516 acres times 18.3%) for treatments above bankfull and 357 acres for treatments below bankfull. Presently, the total acres within a 50-meter riparian buffer on an LCS stream that might be treated on the GPNF under EDRR program that could result in take of listed salmon or steelhead is 2516 acres (Table B4).

Based on the existence of 19 sixth field watersheds on the CRGNSA, the maximum annual extent of habitat that could be modified by EDRR program treatments on the action area is 19 acres (104 acres times 18.3%) for treatments above bankfull and 133 acres for treatments below bankfull (Table B13). Presently the total acres within a 50 meter riparian buffer that might be treated on the CRGNSA under EDRR program that could result in take of listed salmon or steelhead is 104 acres (Table B10).

The foregoing figures are measures of the extent of habitat that could be modified by the proposed action. In that these figures can be planned, observed, and measured, the action agency can readily determine if they are exceeded at any time during the program. Therefore, they represent the limit of the exemption from the prohibition on incidental take provided by this ITS, and if exceeded, the reinitiation provisions of the consultation apply.

Reasonable and Prudent Measures

The Reasonable and Prudent Measures (RPMs) are non-discretionary measures to avoid or minimize take that must be carried out for the exemption in section 7(o)(2) to apply. The GPNF and CRGNSA 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) may lapse if the GPNF and CRGNSA 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. Similarly, if any applicant fails to act in accordance with the terms and conditions of the incidental take statement, protective coverage may lapse.

NMFS believes that full application of the PDCs and buffers included as part of the proposed action, together with use of the RPMs and terms and conditions described below, are necessary and appropriate to minimize the likelihood of incidental take of ESA-listed species due to the proposed action.

The GPNF and CRGNSA shall minimize incidental take by:

1. Minimizing the amount and extent of incidental take from use of herbicides by implementing precautionary measures that keep chemicals out of water.

2. Reporting annual invasive plant control proposals to NMFS via the Level 1 Team by March 1, prior to the start of each spray season (2008 to 2013). The proposals will include the treatment methods, herbicide application methods and rates, objectives of treatments, locations, maps of treatment areas, acreages, proposed start and stop dates, and special mitigation measures that will be applied.

3. Ensuring completion of an annual weed treatment monitoring program by January 31 following each of the 2008 to 2013 spray seasons.

4. Annually reporting by January 31 to NMFS activities implemented during the 2008 to 2013 seasons and the results of their monitoring including acreage of herbicide treatment within the aquatic influence zone, within ditches and dry channels, and below bankfull and along gravel bars to confirm that this Opinion is meeting its objective of limiting the extent of take and minimizing take from permitted activities. If no activities occur, a report of no action is still required by January 31, following each spray season (2008 to 2013).

<u>Terms and Conditions</u>

1. To implement Reasonable and Prudent Measure No. 1, the ONF shall:

    a. Within 3 months of the signing of this Opinion, develop and obtain NMFS's approval, for a rational, implementable rainfall delay approach. Soil active herbicides are excluded from a rain delay when the label states that rainfall soon after application is necessary for effective treatment. If Level 1 Staff are unable to complete the rain delay approach, Level II will complete the task within an additional 60 days.

    b. Implement the rainfall delay approach for the duration of this Opinion.

    c. Within each of the GPNF fifth field watersheds, ensure that the maximum annual below bankfull acres treated does not exceed those listed in Table B7.

d. Within each of the CRGNSA fifth field watersheds, ensure that the maximum annual below bankfull acres treated does not exceed those highlighted in Table B13.

e. Minimize the use of herbicides at maximum application rates (specifically glyphosate and triclopyr), and also limit the use of glyphosate and triclopyr to application rates below typical in any form of spray application.

f. Minimize the use of all forms of chlorsulfuron, imazapic, imazapyr metsulfuron, sethoxydim, sulfometuron, and triclopyr in designated critical habitat.

g. Minimize the use of chlorsulfuron on soils with high ash content.

h. Ensure that all proposed project design features for each activity type be implemented as proposed.

i. Do not use products other than those products evaluated in this Opinion and identified in Table 3.

2. To implement Reasonable and Prudent Measure No. 2, the GPNF and CRGNSA shall:

a. Conduct Level 1 review of annual invasive plant treatment proposals and plans including treatment methods, herbicide application methods and rates, objectives of treatments, locations, maps of treatment areas, acreage, proposed start and completion dates, sensitive areas, and special mitigation for activities involving herbicides by March 1, prior to the spray season. This information is recorded in the "Project Notification Forms." This reporting requirement will commence on March 1, 2008; will follow for each subsequent spraying season by March 1; and will end for this consultation on March 1, 2012. Additional EDRR program sites proposed for immediate treatment may be submitted following the March 1 deadline.

b. Use the NMFS CIRS (http://www.nmfs.noaa.gov/pcts) when this online system becomes available (anticipated date, late 2007), and GPNF staff have been trained to use it.

c. Prior to the CIRS becoming available, the GPNF and CRGNSA shall provide the following information in paper form to the NMFS Washington State Habitat Office (WSHO) for all projects. The following information shall be provided:

(1) A batch of project notification reports will be provided at least 30 days prior to implementation of proposed projects. The reports should contain the following:

a. Location: sixth field HUC, 12 digit code, and name
b. Timing: Anticipated project start and dates
c. Treatment/Restoration Type: Identify all proposed activity types that apply.
d. Project Description: Brief narrative of the project and objectives
e. Extent: Number of stream miles, road miles along streams, acres adjacent to streams, and number of riparian acres to be treated
f. Species Affected: Listed fish and or wildlife species, critical habitat, and or EFH affected by the project.

3. To implement Reasonable and Prudent Measure No. 3, the GPNF and CRGNSA shall:

   a. For application of aquatic glyphosate, aquatic triclopyr, and/or aquatic imazapyr along with herbicide treatments of stream emergent vegetation using spot or hand selective methods, conduct monitoring according to the R6 2005 Monitoring Framework to ensure the PDCs for such treatments are effective.

   b. Each applicator shall maintain a daily log of all invasive treatments, and including the following information:

      (1) The number of acres treated within 50 meters of live water.
      (2) The number of road miles and/or acres.
      (3) The number of acres of below bankfull emergent plant herbicide treatment.
      (4) Identify treatment areas by sixth field HUC.
      (5) The product names, herbicide formulations, including adjuvants and surfactants, used.
      (6) The herbicide application rate.
      (7) The application method.
      (8) Wind speed and air temperature at the time of application.
      (9) Rainfall timing and application dates.
      (10) Additional information required on the FS Herbicide Application Data Form (dated 9/28/06).

   c. The daily logs shall be retained by the GPNF and CRGNSA administrative units, and be available annually in summary form as a part of the FACTS data base by January 31 for review by NMFS, if they are needed.

4. To implement Reasonable and Prudent Measure No. 4, the GPNF and CRGNSA shall:

   a. Annually report to NMFS by January 31, following the end of each spray season for the duration of this Opinion (2008 to 2013 spray seasons), the results of the monitoring plan described in Term and Conditions 3a, 3b, and 3c.

b. Use the NMFS CIRS (http://www.nmfs.noaa.gov/pcts) when this online system becomes available (anticipated launch date April 15, 2007) and GPNF and CRGNSA staff have been trained to use it.

c. Prior to the CIRS becoming available, the GPNF CRGNSA shall provide the following information in paper form to the NMFS Washington State Habitat Office (WSHO) for all projects. The following information shall be provided in summary format:

(1) Project Completion Reports will be provided. This report should contain the elements of term and condition 3c above, as well as the following:

a. Timing: Actual project start and end dates
b. GPNF and CRGNSA contact information: Project lead names.
c. Post-project assessment: The results of the GPNF and CRGNSA' monitoring efforts should be reported to NMFS.
d. Prior to the launch of the CIRS system, the GPNF and CRGNSA shall track implementation of this programmatic consultation to ensure that the amount and extent of take identified above is not exceeded.

NOTICE: If knowledgeable field personnel identify that steelhead or salmon appear injured or killed as a result of herbicide exposure or other project-related activities, the finder should leave the fish alone, make note of any circumstances likely causing the death or injury, location and number of fish involved, and take photographs, if possible. Adult fish should generally not be disturbed unless circumstances arise where an adult fish is obviously injured or killed by herbicide exposure, or some unnatural cause. The finder must contact the Washington Field Office of NMFS Law Enforcement at (360)753-4409 as soon as possible. The finder may be asked to carry out instructions provided by Law Enforcement to collect specimens or take other measures to ensure that evidence intrinsic to the specimen is preserved.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Federal agencies are required, under section 305(b)(2) of the MSA and its implementing regulations (50 CFR 600 Subpart K), to consult with NMFS regarding actions that are authorized, funded, or undertaken by that agency that may adversely affect Essential Fish Habitat (EFH). The MSA section 3 defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." If an action would adversely affect EFH, NMFS is required to provide the Federal action agency with EFH conservation recommendations (section 305(b)(4)(A)). This consultation is based, in part, on information provided by the Federal agency and descriptions of EFH for Pacific coast groundfish, coastal pelagic species, and Pacific salmon contained in the Fishery Management Plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

The Pacific Fishery Management Council (PFMC) designated EFH for Pacific groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), 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 is the action agencies for the proposed Program for the Invasive Plant Treatment Project – Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area. The covered area includes habitats designated as EFH for various life-history stages of Pacific salmon, groundfish, and coastal pelagic species (Table 20). The geographic extent of EFH on the GPNF and CRGNSA is defined as all currently viable waters and most of the habitat historically accessible to Chinook, coho (*O. kisutch*), and pink salmon (*O. gorbuscha*) within the watersheds identified in the BA. Salmon EFH excludes areas upstream of longstanding, naturally impassable barriers. Salmon EFH includes aquatic areas above all artificial barriers.

Table 20. Species of salmon with designated EFH occurring in the Columbia River estuary.

Pacific Salmon Species
Chinook salmon *Oncorhynchus tshawytscha*
coho salmon
O. kisutch

Effects of the Proposed Action on Essential Fish Habitat

Based on information provided in the BA, and 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. The effects analysis for ESA found that herbicide treatment is "likely to adversely affect" habitat quality for LCS, MCS, LCC, LCRC, CC, SBS, SRS, SFC, SSC, UCS, or UCSC in instances where herbicides would be applied in drainages, riparian areas, and ditches upstream from occupied habitat. In addition, herbicides that enter streams are occasionally expected to reach concentrations that cause transient sublethal toxic effects in the above listed salmon and steelhead. However, appreciable water contamination is expected to be infrequent and limited in area and duration due to the relatively small amounts and rates of chemicals that will be applied in a given area, implementation of PDCs to reduce water contamination, and the limited amount of acreage treated relative to the overall watersheds.

Water contamination from herbicides is expected to occur when precipitation carries the herbicides to water through overland flow, percolation, or in shallow ground water; and when herbicides fall directly in the water from spray drift stemming from treatments within ditches, dry channels, and perennial streams or along the riparian corridor, or by accidentally directing the application stream into water. The likelihood of contamination is minimized in the proposed action through the use of PDCs but contamination cannot be completely avoided since the likelihood of contamination is partly dependant on the weather at the time of, and following herbicide application. The herbicides proposed for use are generally transported readily in water and circumstances where herbicides are mobilized such as wind, rain and snow are likely to occur before all of the herbicides have broken down. Consequently, site-specific circumstances such as soil characteristics, vegetation, topography and weather during and following herbicide application will determine the frequency, severity, and duration of habitat impairment due to water contamination by herbicides. The exact locations where water contamination will occur and concentrations of herbicides once they reach water cannot be predicted since none of the above factors affecting chemical transport are known ahead of time.

When water contamination occurs, it is likely to be transient and localized. For an herbicide to have an adverse effect on EFH, the chemical must be of sufficient concentration or duration in water to cause a reduction in the quantity or quality of EFH. A reduction in quality or quantity of EFH from herbicide contamination is indicated by exposures that are sufficient to cause a behavioral or physiological effect in Chinook salmon. In the limited circumstances where toxic thresholds are reached, the effects are likely to be sublethal and herbicide concentrations are likely to rapidly drop with increasing distance from the treatment area due to dispersion of the herbicides and increasing stream discharge. Most of the herbicides proposed for use break down chemically in a matter of months, although clopyralid and picloram may be present in the environment for much longer. Under the worst possible contamination scenario under the proposed action, herbicides are not likely to reach lethal concentrations, sublethal concentrations would likely occur in only a few treatment locations, and sublethal effects would persist for no longer than roughly one year or less.

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 and herbicides to streams through in-water and riparian invasive plant treatment, and temporary loss of riparian vegetation prior to full riparian vegetation restoration.

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 (chemical) from in-water, ditch and riparian herbicide treatments.
2. 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

NMFS believes that the following conservation recommendations are adequate to avoid, minimize, or otherwise offset the potential adverse effects, described above, from these activities to designated EFH for Chinook salmon, and coho salmon. NMFS understands that the FS has an obligation under the ESA to implement these conservation recommendations. As such, these conservation recommendations will also act, under the MSA, to minimize potential adverse effects on the maximum extent practicable. NMFS recommends tracking the implementation of invasive plant treatment actions that occur in EFH. The Action Agencies should implement the following conservation recommendations:

1. RPM No. 1, and associated terms and conditions 1a. to 1i. in the Opinion above.
2. RPM No. 2, and associated terms and conditions 2a. to 2c. in the Opinion above.
3. RPM No. 3, and associated terms and conditions 3a. to 3c. in the Opinion above.
4. RPM No. 4, and associated terms and conditions 4a. to 4c. in the Opinion above.

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)]. Thus, a written response to this consultation is necessary.

Supplemental Consultation

The Action Agency 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, 2011.

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 (DQA)) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: The intended user of this consultation is the GPNF and CRGNSA and the information in this consultation will be useful to citizens and groups with interest in land management activities carried out on the forest and scenic area. These include Washington residents, local and county government officials and employees.

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 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 A – Description of herbicides proposed for use.

Chemical/Selected Brand Names/Action	Properties	General Uses/Known to be Effective on:
Chlorsulfuron (Telar,Glean,Corsair)/ Sulfonylurea-Interferes with enzyme acetolactate synthase w/ rapid cessation of cell division and plant growth in shoots and roots.	Glean -Selective pre-emergent or early post-emergent Telar – Selective pre- and post-emergent. Both are for many annual, biennial and perennial broadleaf species. Safe for most perennial grasses, conifers. Some soil residue.	Use at very low rates on annual, biennial and perennial species: especially dalmation toadflax, and houndstongue and perennial pepperweed.
Clopyralid (Transline)/ Synthetic auxin -Mimics natural plant hormones.	A highly translocated, selective herbicide active primarily through foliage of broadleaf species. Little effect on grasses.	Particularly effective on Asteraceae, Fabaceae, Polygonaceae, Solanaceae. Some species include knapweeds, yellow starthistle, Canada thistle, hawkweeds. Provides control of new germinants for one to two growing seasons.
Dicamba (Banvel , Vanquish) Synthetic auxin -Mimics natural plant hormones.	Used for the control of a variety of broadleaf and woody vegetation. Banvel is more likely to generate dicamba vapor than Vanquish.	Selective against many annual and perennial broadleaf species including woody and vine species (e.g. gorse, hawkweeds, tansy ragwort).
Glyphosate (RoundUp, Rodeo etc.)/ Inhibits three amino acids and protein synthesis.	A broad spectrum, non-selective translocated herbicide with no apparent soil activity. Adheres to soil which lessens or retards leaching or uptake by non-targets.	Low volume applications are most effective. Translocates to roots and rhizomes of perennials. While considered non-selective, sensitivities do vary depending on species. Main control for purple loosestrife, herb Robert, English ivy and reed canarygrass. Aquatic labeled formulations can be used near water.
Imazapic (Plateau)/Inhibits the plant enzyme acetolactate, which prevents protein synthesis.	Used for the control of some broadleaf plants and some grasses.	Use at low rates can control leafy spurge, cheatgrass, medusa head rye, toadflaxes and houndstongue
Imazapyr (Arsenal, Chopper, Stalker Habitat)/ Inhibits the plant enzyme acetolactate, which prevents protein synthesis.	Broad spectrum, non-selective pre- and post-emergent for annual and perennial grasses and broadleaved species.	Most effective as a post-emergent. Has been used on cheatgrass, whitetop, perennial pepperweed, dyers woad, tamarisk, woody species, and spartina. Aquatic labeled formulations can be used near water.

Chemical/Selected Brand Names/Action	Properties	General Uses/Known to be Effective on:
Metsulfuron methyl (Escort)/ Sulfonylurea - Inhibits acetolactate synthesis. protein synthesis inhibitor. block formation of amino acids.	Used for the control of many broadleaf and woody species. Most susceptible crop species in the Lily family (i.e. onions. Allium). Safest sulfonylurea around non-target grasses.	Use at low rates to control such species as houndstongue. sulfur cinquefoil perennial pepperweed.
Picloram (Tordon) Restricted Use Herbicide Synthetic auxin - Mimics natural plant hormones.	Selective. systemic for many annual and perennial broadleaf herbs and woody plants.	Use at low rates to control such species as knapweeds. Canada thistle. yellow starthistle. houndstongue. toadflaxs. sulfur cinquefoil. and hawkweeds. Provides control of new germinants for two to three growing seasons.
Sethoxydim (Poast)/ Inhibits acetyl co-enzyme. a key step for synthesis of fatty acids.	A selective. post-emergent grass herbicide.	Will control many annual and perennial grasses such as cheatgrass.
Sulfometuron methyl (Oust)/ Sulfonylurea -Inhibits acetolactase synthase. a key step in branch chain amino acid synthesis.	Broad spectrum pre- and post-emergent herbicide for both broadleaf species and grasses.	Used at low rates as a pre-emergent along roadsides. Known to be effective on canary reedgrass. (but not labeled for aquatic use) cheatgrass. medusahead.
Triclopyr (Garlon. Pathfinder. Remedy)/ Synthetic auxin - Mimics natural plant hormones.	A growth regulating selective. systemic herbicide for control of woody and broadleaf perennial weeds. Little or no impact on grasses.	Not for broadcast application under proposed action. Effective for many woody species such as scotch broom and blackberry. Also effective on English ivy. Japanese knotweed. Amine formulation may be used near water
2,4-D (Weedone. Weedar. many more) Synthetic auxin - Mimics natural plant hormones.	Readily absorbed and metabolized. Used for the control of many broadleaf species.	Effective for many broadleaf species (such as Canada thistle. Russian knapweed. sulfur cinquefoil. hoary cress). Aquatic labeled formulations can be used near water.

Risk information found in SERA documents (2.4-D 1998. Triclopyr 2003. Picloram 2003. Sethoxydim 2001. Glyphosate 2003. all others 2004) for each active ingredient. Information on species effectiveness in Tu et al. (2001) or from product labels.

Copied from the **Pacific Northwest Region Invasive Plant Program Preventing and Managing Invasive Plants Final Environmental Impact Statement -** April 2005.

NPE and related compounds are used as surfactants in pesticide products as “inert” ingredients. They are used to increase the amount of a spray solution that remains on leaf surfaces, to make the spray droplets stick better to the leaf, and in general make the pesticide product more potent. NPE and their breakdown products are acutely toxic to fish, and relatively low concentrations can cause death (Cox 2003).

The median lethal concentrations of NPE and its breakdown products (LC50 is the concentration in water that kills 50 percent of a population of test animals) for Atlantic salmon and fathead minnows are between 0.1 and 8.5 parts per million (ppm) (Müller

1980). At concentrations around 1 ppm, nonyl phenol kills rainbow trout eggs (National Research Council of Canada 1982).

In general, ethoxylates with a small number of ethylene oxide units tend to be most toxic, and juveniles are more susceptible than adults (Cox 2003). Fish gills are particularly sensitive to the presence of surfactants, and several studies have documented the destruction and marked deterioration of gills exposed to nonyl phenol ethoxylates (Miossec and Bocquene 1984; Pärt et al. 1985).

Nonyl phenol is estrogenic in fish. This has been demonstrated by measuring the production of vitellogenin, a component of the yolk of a fish egg. Vitellogenin is produced by fish livers in response to estrogens. Males will produce vitellogenin if exposed to estrogenic chemicals. Using cultures of liver cells from male rainbow trout, researchers showed that octyl phenol, nonyl phenol, nonyl phenol carboxylic acid, and some nonyl phenol ethoxylates were estrogenic (Jobling and Sumpter. 1993). More recently, the same researchers studied male fish living in water contaminated with alkyl phenols. Nonyl phenol increased vitellogenin production at concentrations of 10 parts per billion (ppb), while octyl phenol was active at even lower concentrations (3 ppb). Living in water with just 50 ppb of nonyl phenol caused a decrease in the size of the trout's testes. These concentrations are much lower than those that caused effects in the earlier cell culture tests (Jobling et al. 1996).

Most recent studies continue to refine the estrogenic effects from NPE and its breakdown products in fish. Results indicate that exposure of anadromous salmonids to environmental estrogens in the 10 – 100 ppb range heightened sensitivity to external stressors, impaired ion regulation in freshwater, and disrupted endocrine pathways critical for smolt development (Lerner et al. 2007a; Lerner et al. 2007b).

Appendix B – GIS data tables

Table B1. Proposed Invasive Plant Treatment Areas in the GPNF. Total acreage based on GPNF's calculation of gross treatment acres.

	A	B	C	D	E	F
2	Treatment ID	Site Description	Acres	Treatment ID	Site Description	Acres
3	31-01a	RoadPlus	1,391.8	33-06r3	Parking	18.9
4	31-01q	Quarry	24.3	33-07m	Meadow	359.5
5	31-01r2	CampDispersed	35.0	33-07q	Quarry	6.8
6	31-08q	Quarry	8.7	33-07r0	Admin	33.6
7	31-08qa	Quarry	1.5	33-07r2	CampDispersed	8.0
8	31-08r2	CampDispersed	0.5	33-07r3	Parking	55.8
9	31-08r3	Parking	28.8	33-07r4	Viewpoint	175.2
10	31-09q	Quarry	14.2	33-11	RoadPlus	2,023.4
11	31-09qa	Quarry	1.8	33-11a	RoadPlus	607.7
12	31-09r1	Campground	20.7	33-11m1	Meadow	3.7
13	31-09r2	CampDispersed	7.7	33-11q	Quarry	8.5
14	31-10q	Quarry	10.6	33-11qa	Quarry	1.6
15	31-10qa	Quarry	1.7	33-11r1	Campground	144.2
16	31-10r1	Campground	13.4	33-11r2	CampDispersed	0.7
17	31-10r3	Parking	7.7	33-11r3	Parking	35.2
18	31-10r4	Viewpoint	48.4	33-12a	RoadPlus	2,183.0
19	31-19q	Quarry	8.1	33-12q	Quarry	33.8
20	31-19qa	Quarry	1.7	33-12qa	Quarry	4.8
21	31-19r2	CampDispersed	0.5	33-12r1	Campground	302.8
22	33-03q	Quarry	7.5	33-12r2	CampDispersed	6.6
23	33-03qa	Quarry	2.6	33-12r3	Parking	29.8
24	33-03r0	Admin	47.6	33-12r4	Viewpoint	17.5
25	33-03r1	Campground	24.7	35-13q	Quarry	26.7
26	33-03r2	CampDispersed	3.4	35-14	RoadPlus	2,736.3
27	33-03r3	Parking	14.1	35-14a	RoadPlus	1,370.6
28	33-04	RoadPlus	3,293.7	35-14m	Meadow	575.4
29	33-04m1	Meadow	35.1	35-14m1	Meadow	39.8
30	33-04p1	Plantation	189.6	35-14m2	Meadow	52.5
31	33-04q	Quarry	11.8	35-14m3	Meadow	7.3
32	33-04r1	Campground	35.7	35-14p	Plantation	35.6
33	33-04r3	Parking	33.2	35-14q	Quarry	25.7
34	33-04r4	Viewpoint	2.1	35-14qa	Quarry	3.3
35	33-05	RoadPlus	6,187.3	35-14r1	Campground	47.1
36	33-05a	RoadPlus	1,466.4	35-14r3	Parking	80.0
37	**33-05m1**	**Meadow**	**89.8**	35-14r4	Viewpoint	5.5
38	33-05m3	Meadow	150.6	35-16a	RoadPlus	2,371.1
39	33-05m4	Meadow	31.8	35-16q	Quarry	49.7
40	33-05p1	Plantation	5.7	35-16qa	Quarry	12.3
41	33-05p2	Plantation	434.2	35-16r0	Admin	50.4
42	33-05q	Quarry	30.9	35-16r1	Campground	145.9
43	33-05qa	Quarry	5.0	35-16r3	Parking	33.0
44	33-05r0	Admin	19.4	35-16r4	Viewpoint	18.0
45	33-05r1	Campground	325.9	35-17q	Quarry	35.8
46	33-05r2	CampDispersed	1.7	35-17qa	Quarry	1.7
47	33-05r3	Parking	49.2	35-17r1	Campground	15.6
48	33-05r4	Viewpoint	3.1	35-17r3	Parking	9.6
49	33-06q	Quarry	6.5	35-18	RoadPlus	894.5
50	33-06qa	Quarry	1.6	35-18q	Quarry	14.4
51	33-06r1	Campground	44.3	35-18qa	Quarry	1.7
52	33-06r2	CampDispersed	4.3	35-18r1	Campground	143.3
53	33-06r3	Parking	18.9	35-18r3	Parking	1.6
54					**GPNF Totals**	**29,051.4**

Bolded site include invasive plant treatments below bankfull, in addition to treatment above bankfull.
Source: GPNF GIS data. V. Harke, USFWS. July 25, 2007

Table B2. Proposed Invasive Plant Treatment Areas in the CRGNSA. Total acreage based on CRGNSA's calculation of gross treatment acres.

Proposed Invasive Plant Treatment Areas on the CRGNSA

TREATMENT_	SITE_DESCR	LOCATION	ACRES
22-02	Clearing	Mt. Pleasant	107.5
22-03	**Clearing**	**St. Cloud/Sam Walker/HVF**	**65.1**
22-04	**Wetland**	**Bonneville Hot Springs**	**5.3**
22-06	**GeneralForest**	**Collin's Slide**	**295.9**
22-09	GeneralForest	Burdoin/Catherine Cr./Major Cr.	88.2
22-10	GeneralForest	Balfour	66.9
22-13	**GeneralForest**	**Miller Island**	**348.9**
22-14	GeneralForest	Wishram	19.3
22-15	Clearing	South BZ	18.3
22-16	Clearing	Klickitat Rails-to-trails	100.8
		CRGNSA Totals	**1,116.3**

Source: CRGNSA GIS data
V. Harke, USFWS, July 25, 2007

Bolded sites include invasive plant treatments below bankfull, in addition to treatments above bankfull.

Table B3. Summary of GPNF road miles and number of stream crossings within invasive plant treatment areas by fifth-field watershed within the LCS habitat.

5th-Field Watershed Name	Total Road Miles Located within Treatmen t Areas	Treatment Area Roads (miles) located within 50 m of LCS streams	Treatmen t Area Roads (miles) located within 660ft of LCS streams	Total stream crossings located in Treatmen t Areas (all stream types)	LCS Stream Crossings located directly over LCS streams in Treatment Areas	Total stream crossings located within 660 ft of LCS Streams in Treatment Areas (all stream types*)
Wind River	1.98	0.04	0.70	0	0	0
Wind River	7.09	0.05	0.12	13	1	1
Wind River	1.38	0.35	1.33	7	1	5
Wind River	0.10	0.00	0.10	1	0	0
Wind River	1.50	0.01	0.20	1	0	0
Wind River	47.70	0.44	2.19	132	3	4
Wind River	14.89	0.00	0.00	45	0	0
Wind River	5.07	0.00	0.62	6	0	0
Wind River	**79.73**	**0.89**	**5.26**	**205.00**	**5.00**	**10.00**
Washougal River	2.91	0.00	0.00	1	0	0
Washougal River	0.00	0.00	0.00	0	0	0
Washougal River	0.00	0.00	0.00	0	0	0
Washougal River	**2.91**	**0.00**	**0.00**	**1.00**	**0.00**	**0.00**
East Fork Lewis River	12.54	1.84	3.62	21	3	11
East Fork Lewis River	8.66	3.10	5.95	22	3	18
East Fork Lewis River	0.00	0.00	0.00	0	0	0
East Fork Lewis River	**21.20**	**4.94**	**9.57**	**43.00**	**6.00**	**29.00**
Clearfork Cowlitz Riv.	7.64	0.00	0.66	18	0	0
Clearfork Cowlitz Riv.	60.38	0.56	3.97	193	3	5
Clearfork Cowlitz Riv.	6.35	0.00	1.19	12	0	1
Clearfork Cowlitz Riv.	**74.38**	**0.57**	**5.82**	**223.00**	**3.00**	**6.00**
Upper Cowlitz River	23.83	0.04	1.00	70	0	2
Upper Cowlitz River	18.30	0.00	0.17	45	0	0
Upper Cowlitz River	11.86	0.00	0.11	43	0	0
Upper Cowlitz River	45.93	0.00	0.00	69	0	0
Upper Cowlitz River	15.69	0.05	0.80	43	0	1
Upper Cowlitz River	32.54	0.00	0.06	111	0	0
Upper Cowlitz River	**148.15**	**0.09**	**2.13**	**381.00**	**0.00**	**3.00**
Middle Cowlitz River	13.80	0.00	0.00	76	0	0
Middle Cowlitz River	0.13	0.00	0.00	0	0	0
Middle Cowlitz River	0.31	0.00	0.00	0	0	0
Middle Cowlitz River	1.10	0.00	0.00	3	0	0
Middle Cowlitz River	0.00	0.00	0.00	0	0	0
Middle Cowlitz River	0.00	0.00	0.00	0	0	0
Middle Cowlitz River	7.78	0.00	0.59	17	0	2
Middle Cowlitz River	**23.12**	**0.00**	**0.59**	**96.00**	**0.00**	**2.00**

Table B3 continued.

5th-Field Watershed Name	Total Road Miles Located within Treatment Areas	Treatment Area Roads (miles) located within 50 m of LCS streams	Treatment Area Roads (miles) located within 660ft of LCS streams	Total stream crossings located in Treatment Areas (all stream types)	LCS Stream Crossings located directly over LCS streams in Treatment Areas	Total stream crossings located within 660 ft of LCS Streams in Treatment Areas (all stream types*)
Upper Cispus River	41.87	0.06	1.57	68	1	5
Upper Cispus River	41.20	0.00	0.00	128	0	0
Upper Cispus River	7.88	0.11	2.46	47	0	8
Upper Cispus River	25.97	0.67	6.61	78	3	17
Upper Cispus River	**116.91**	**0.84**	**10.64**	**321.00**	**4.00**	**30.00**
Lower Cispus River	22.57	0.11	2.59	57	1	3
Lower Cispus River	9.80	0.00	0.00	36	0	0
Lower Cispus River	15.21	0.25	2.63	23	3	7
Lower Cispus River	10.47	0.06	0.41	21	1	1
Lower Cispus River	19.48	0.13	0.69	64	1	2
Lower Cispus River	4.73	0.46	2.03	10	1	4
Lower Cispus River	0.27	0.00	0.00	0	0	0
Lower Cispus River	10.61	0.19	3.61	35	0	12
Lower Cispus River	**93.14**	**1.21**	**11.96**	**246.00**	**7.00**	**29.00**
Riffe Reservoir - Cowlitz River	**0.00**	**0.00**	**0**	**0**	**0**	0
Tilton River	0.00	0.00	0.00	0	0	0
Tilton River	0.00	0.00	0.00	0	0	0
Tilton River	0.00	0.00	0.00	0	0	0
Tilton River	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
North Fork Toutle River	2.21	0.00	0.50	0	0	0
North Fork Toutle River	1.48	0.00	0.01	6	0	0
North Fork Toutle River	**3.69**	**0.00**	**0.52**	**6.00**	**0.00**	**0**
Green River	0.21	0.00	0.00	1	0	0
Green River	0.00	0.00	0.00	0	0	0
Green River	**0.21**	**0.00**	**0.00**	**1.00**	**0.00**	**0**
South Fork Toutle River	**0.19**	**0.00**	**0**	**3**	**0**	**0**
Totals	**563.62**	**8.53**	**46.49**	**1526.00**	**25.00**	**109.00**

* Feeder streams and tributaries of LCS streams

Bolded totals represent sums of all 6th field subwatersheds within each 5th field watershed.

Total acres/stream miles = gross estimates including inholdings w/in GPNF administrative boundary.

This table was created using ArcGIS data.

Lower Columbia River steelhead critical habitat is from NOAA-NMFS

Critical habitat miles within the Tilton River drainage were proposed, but excluded in the final rule.

Forest boundary is from GPNF GIS data.

V.Harke, USFWS October 3, 2007

Table B4. Summary of GPNF Treatments located within 50 meter Riparian buffer.

5th-Field Watershed Name	6th-Field Sub-watershed Name	Total Treatment Acres in 6th-field watershed	Treatment Acres Located within 50m buffers of all streams	Percent of Treatments located within 50m buffers	Treatment Acres located within 50m of LCS Streams	Percent of Treatments within 50 m of LCS Streams
Wind River	Upper Wind River	57	6.4	11.3%	6.4	11.2%
Wind River	Falls Creek	106	23.7	22.4%	2.7	2.6%
Wind River	Dry Creek-Wind River	55	35.3	64.5%	30.3	55.5%
Wind River	Middle Wind River	32	16.5	52.2%	5.6	17.8%
Wind River	Trout Creek	30	7.1	23.3%	3.0	9.9%
Wind River	Panther Creek	717	191.9	26.8%	12.3	1.7%
Wind River	Bear Creek	233	76.0	32.6%	0.0	0.0%
Wind River	Lower Wind River	79	16.8	21.4%	0.1	0.2%
5th-field Total		**1,309**	**374**	**28.6%**	**60**	**4.6%**
Washougal River	**Headwaters Washougal River**	**39**	**3.4**	**8.6%**	**0.0**	**0.0%**
East Fork Lewis River	East Fork Lewis River Headwaters	166	43.8	26.4%	27.8	16.7%
East Fork Lewis River	Upper East Fork Lewis River	126	62.9	50.1%	47.2	37.6%
5th-field Total		**291**	**107**	**36.6%**	**75**	**25.7%**
Clearfork Cowlitz River	Ohanapecosh River	172	44.5	25.9%	5.5	3.2%
Clearfork Cowlitz River	Clear Fork of the Cowlitz River	1,397	433.0	31.0%	46.5	3.3%
Clearfork Cowlitz River	Muddy Fork of the Cowlitz River	102	22.8	22.4%	0.1	0.1%
5th-field Total		**1,670**	**500**	**30.0%**	**52**	**3.1%**
Upper Cowlitz River	Coal Creek	396	101.8	25.7%	0.8	0.2%
Upper Cowlitz River	Lake Creek	317	70.6	22.3%	0.0	0.0%
Upper Cowlitz River	Butter Creek	181	52.1	28.8%	0.0	0.0%

Table B4 continued.

5th-Field Watershed Name	6th-Field Sub-watershed Name	Total Treatment Acres in 6th-field watershed	Treatment Acres Located within 50m buffers of all streams	Percent of Treatments located within 50m buffers	Treatment Acres located within 50m of LCS Streams	Percent of Treatments within 50 m of LCS Streams
Upper Cowlitz River	Hall Creek	787	135.8	17.2%	0.0	0.0%
Upper Cowlitz River	Skate Creek	237	60.2	25.4%	0.9	0.4%
Upper Cowlitz River	Johnson Creek	583	195.3	33.5%	0.5	0.1%
5th-field Total		**2,502**	**616**	**24.6%**	**2**	**0.1%**
Middle Cowlitz River	Smith Creek	193	74.0	38.4%	0.0	0.0%
Middle Cowlitz River	Willame Creek	9	0.5	6.0%	0.0	0.0%
Middle Cowlitz River	Kilborn Creek-Cowlitz River	5	0.0	0.0%	0.0	0.0%
Middle Cowlitz River	Davis Creek-Cowlitz River	26	6.0	22.6%	0.0	0.0%
Middle Cowlitz River	Silver Creek	7	2.2	32.4%	0.0	0.0%
Middle Cowlitz River	Siler Creek	137	26.8	19.7%	0.0	0.0%
5th-field Total		**376**	**109**	**29.1%**	**0**	**0.0%**
Upper Cispus River	Cat Creek-Cispus River	662	127.7	19.3%	0.9	0.1%
Upper Cispus River	East Canyon Creek	709	189.2	26.7%	0.0	0.0%
Upper Cispus River	Blue Lake-Cispus River	117	49.5	42.4%	2.1	1.8%
Upper Cispus River	North Fork Cispus River	414	117.9	28.5%	18.3	4.4%
5th-field Total		1,901	484	25.5%	21	1.1%

Table B4 continued.

5th-Field Watershed Name	6th-Field Sub-watershed Name	Total Treatment Acres in 6th-field watershed	Treatment Acres Located within 50m buffers of all streams	Percent of Treatments located within 50m buffers	Treatment Acres located within 50m of LCS Streams	Percent of Treatments within 50 m of LCS Streams
Lower Cispus River	Yellowjacket Creek	328	72.5	22.1%	1.3	0.4%
Lower Cispus River	McCoy Creek	142	41.8	29.3%	0.0	0.0%
Lower Cispus River	Camp Creek-Cispus River	279	36.6	13.1%	7.1	2.5%
Lower Cispus River	Greenhorn Creek	148	25.8	17.4%	0.9	0.6%
Lower Cispus River	Iron Creek	446	124.3	27.8%	7.0	1.6%
Lower Cispus River	Woods Creek	125	30.0	24.0%	11.2	9.0%
Lower Cispus River	Quartz Creek	43	7.7	17.8%	0.0	0.0%
Lower Cispus River	Lower Cispus River Frontal	236	57.8	24.5%	17.3	7.3%
5th-field Total		**1,748**	**396**	**22.7%**	**45**	**2.6%**
Riffe Reservoir - Cowlitz River	**Goat Creek**	**37**	**26.1**	**71.4%**	**0.0**	**0.0%**

Table B4 continued.

5th-Field Watershed Name	6th-Field Sub-watershed Name	Total Treatment Acres in 6th-field watershed	Treatment Acres Located within 50m buffers of all streams	Percent of Treatments located within 50m buffers	Treatment Acres located within 50m of LCS Streams	Percent of Treatments within 50 m of LCS Streams
Tilton River	West Fork Tilton River	2	1.5	90.8%	0.0	0.0%
Tilton River	North Fork Tilton River	3	0.1	3.1%	0.0	0.0%
5th-field Total		**4**	**2**	**36.9%**	**0**	**0.0%**
North Fork Toutle River	Coldwater Creek	147	16.6	11.3%	0.0	0.0%
North Fork Toutle River	North Fork Toutle River	153	68.4	44.8%	0.0	0.0%
5th-field Total		**300**	**85**	**28.3%**	**0**	**0.0%**
Green River	**Upper Green River**	**30**	**10.0**	**33.1%**	**0.0**	**0.0%**
South Fork Toutle River	**South Fork Toutle Headwaters**	**123**	**58.5**	**47.7%**	**0.0**	**0.0%**
		10,330	**2,772**	**26.8%**	**256**	**2.5%**

Total acres and stream miles on GPNF are gross estimates that include inholdings within the GPNF administrative boundary.
Lake areas (i.e., Riffe Lake) are included in stream length estimates.
This table was created using ArcGIS data.
Lower Columbia River steelhead critical habitat is from NOAA-NMFS
Critical habitat miles within the Tilton River drainage were proposed, but excluded in the final rule.
Forest boundary is from GPNF GIS data.
V.Harke, USFWS October 2, 2007

Table B5. Summary of Road Miles within Invasive Plant Treatment Areas within the GPNF.

5th-Field Watershed Name	HUC5	HUC6	6th-Field Sub-watershed Name	GPNF acres in subwatershed	Total Road Miles on GPNF in Subwatershed	Total Road Miles Located within Treatment Areas	Percent of Total Roads in Treatment Areas
Wind River	1707010512	170701051201	Upper Wind River	20,063	79.16	1.98	2.5%
Wind River	1707010512	170701051202	Falls Creek	13,891	46.23	7.09	15.3%
Wind River	1707010512	170701051203	Dry Creek-Wind River	17,370	36.37	1.38	3.8%
Wind River	1707010512	170701051204	Middle Wind River	17,222	86.55	0.10	0.1%
Wind River	1707010512	170701051205	Trout Creek	21,365	98.39	1.50	1.5%
Wind River	1707010512	170701051206	Panther Creek	25,924	106.03	47.70	45.0%
Wind River	1707010512	170701051207	Bear Creek	9,282	21.50	14.89	69.3%
Wind River	1707010512	170701051208	Lower Wind River	7,855	25.57	5.07	19.8%
Washougal River	1708000108	170800010801	Headwaters Washougal River	7,454	12.88	2.91	22.6%
Washougal River	1708000108	170800010802	Washougal River-Dougan Creek	997	0.03	0.00	0.0%
Washougal River	1708000108	170800010803	West Fork Washougal River	3,319	1.58	0.00	0.0%
East Fork Lewis River	1708000205	170800020501	East Fork Lewis River Headwaters	9,541	32.12	12.54	39.0%
East Fork Lewis River	1708000205	170800020502	Upper East Fork Lewis River	9,704	45.51	8.66	19.0%
East Fork Lewis River	1708000205	170800020505	Rock Creek	1,215	0.08	0.00	0.0%

Table B5 continued.

5th-Field Watershed Name	HUC5	HUC6	6th-Field Sub-watershed Name	GPNF acres in subwatershed	Total Road Miles on GPNF in Subwatershed	Total Road Miles Located within Treatment Areas	Percent of Total Roads in Treatment Areas
Clearfork Cowlitz River	1708000401	170800040101	Ohanapecosh River	2,025	9.71	7.64	78.7%
Clearfork Cowlitz River	1708000401	170800040103	Clear Fork of the Cowlitz River	38,323	69.57	60.38	86.8%
Clearfork Cowlitz River	1708000401	170800040104	Muddy Fork of the Cowlitz River	9,606	7.01	6.35	90.6%
Upper Cowlitz River	1708000402	170800040201	Coal Creek	10,614	26.82	23.83	88.9%
Upper Cowlitz River	1708000402	170800040202	Lake Creek	16,304	20.67	18.30	88.5%
Upper Cowlitz River	1708000402	170800040203	Butter Creek	9,568	12.55	11.86	94.5%
Upper Cowlitz River	1708000402	170800040204	Hall Creek	8,159	53.85	45.93	85.3%
Upper Cowlitz River	1708000402	170800040205	Skate Creek	20,791	68.15	15.69	23.0%
Upper Cowlitz River	1708000402	170800040206	Johnson Creek	31,038	62.88	32.54	51.8%
Middle Cowlitz River	1708000403	170800040301	Smith Creek	10,203	27.49	13.80	50.2%
Middle Cowlitz River	1708000403	170800040302	Willame Creek	13,437	64.50	0.13	0.2%
Middle Cowlitz River	1708000403	170800040303	Kilborn Creek-Cowlitz River	14,788	18.92	0.31	1.6%
Middle Cowlitz River	1708000403	170800040304	Davis Creek-Cowlitz River	12,172	36.77	1.10	3.0%

Table B5 continued.

5th-Field Watershed Name	HUC5	HUC6	6th-Field Sub-watershed Name	GPNF acres in subwatershed	Total Road Miles on GPNF in Subwatershed	Total Road Miles Located within Treatment Areas	Percent of Total Roads in Treatment Areas
Middle Cowlitz River	1708000403	170800040305	Silver Creek	31,991	223.87	0.00	0.0%
Middle Cowlitz River	1708000403	170800040306	Kiona Creek	7,528	46.28	0.00	0.0%
Middle Cowlitz River	1708000403	170800040307	Siler Creek	5,954	42.14	7.78	18.5%
Upper Cispus River	1708000404	170800040405	Cat Creek-Cispus River	18,777	80.99	41.87	51.7%
Upper Cispus River	1708000404	170800040407	East Canyon Creek	18,307	60.94	41.20	67.6%
Upper Cispus River	1708000404	170800040408	Blue Lake-Cispus River	15,637	38.67	7.88	20.4%
Upper Cispus River	1708000404	170800040409	North Fork Cispus River	27,908	115.61	25.97	22.5%
Lower Cispus River	1708000405	170800040501	Yellowjacket Creek	29,707	110.82	22.57	20.4%
Lower Cispus River	1708000405	170800040502	McCoy Creek	12,838	22.47	9.80	43.6%
Lower Cispus River	1708000405	170800040503	Camp Creek-Cispus River	11,612	69.25	15.21	22.0%
Lower Cispus River	1708000405	170800040504	Greenhorn Creek	9,994	40.57	10.47	25.8%
Lower Cispus River	1708000405	170800040505	Iron Creek	23,105	124.33	19.48	15.7%

Table B5 continued.

5th-Field Watershed Name	HUC5	HUC6	6th-Field Sub-watershed Name	GPNF acres in subwatershed	Total Road Miles on GPNF in Subwatershed	Total Road Miles Located within Treatment Areas	Percent of Total Roads in Treatment Areas
Lower Cispus River	1708000405	170800040506	Woods Creek	6,858	40.58	4.73	11.7%
Lower Cispus River	1708000405	170800040507	Quartz Creek	12,826	27.07	0.27	1.0%
Lower Cispus River	1708000405	170800040508	Lower Cispus River Frontal	8,035	28.58	10.61	37.1%
Riffe Reservoir - Cowlitz River	1708000501	170800050101	Goat Creek	9,849	15.25	0.00	0.0%
Tilton River	1708000502	170800050202	West Fork Tilton River	10,520	68.79	0.00	0.0%
Tilton River	1708000502	170800050203	Middle Tilton River	4,648	22.82	0.00	0.0%
Tilton River	1708000502	170800050204	North Fork Tilton River	20,571	155.15	0.00	0.0%
North Fork Toutle River	1708000504	170800050401	Coldwater Creek	30,311	43.41	2.21	5.1%
North Fork Toutle River	1708000504	170800050402	North Fork Toutle River	15,072	36.07	1.48	4.1%
Green River	1708000505	170800050501	Upper Green River	17,906	26.85	0.21	0.8%
Green River	1708000505	170800050502	Middle Green River	8,819	40.06	0.00	0.0%
South Fork Toutle River	1708000506	170800050601	South Fork Toutle Headwaters	8,137	13.34	0.19	1.4%
Totals				**729,141**	**2,564.80**	**563.62**	**22.0%**
Total acres/stream miles = gross estimates including inholdings w/in GPNF administrative boundary.							
This table was created using ArcGIS data.							
Lower Columbia River steelhead critical habitat is from NOAA-NMFS							
Critical habitat miles within the Tilton River drainage were proposed, but excluded in the final rule.							
Forest boundary is from GPNF GIS data.							
V.Harke, USFWS October 3, 2007							

Table B6. Summary of GPNF watershed acres.

Sub-basin (4th-Field)	5th-Field Watershed Name	HUC5	Total Acres in Watershed	Watershed acres within GPNF boundary	Percent of watershed acres within GPNF boundary
MIDDLE COLUMBIA/HOOD	WIND RIVER	1707010511	143,641	132,973	93%
MIDDLE COLUMBIA/HOOD	MIDDLE COLUMBIA/G RAYS CREEK	1707010512	55,680	6,820	12%
MIDDLE COLUMBIA/HOOD	MIDDLE COLUMBIA/E AGLE CREEK	1707010513	40,150	10,803	27%
LOWER COLUMBIA/SANDY	WASHOUGAL RIVER	1708000106	136,182	11,770	9%
LEWIS	EAST FORK LEWIS RIVER	1708000205	149,904	29,829	20%
LEWIS	LOWER LEWIS RIVER	1708000206	141,724	24,601	17%
LOWER COLUMBIA/CLATSKA NIE	KALAMA RIVER	1708000301	151,360	14,106	9%
UPPER COWLITZ	HEADWATER S COWLITZ RIVER	1708000401	138,418	71,028	51%
UPPER COWLITZ	UPPER COWLITZ RIVER	1708000402	106,935	96,520	90%
UPPER COWLITZ	COWLITZ VALLEY FRONTAL	1708000403	132,396	96,989	73%
UPPER COWLITZ	UPPER CISPUS RIVER	1708000404	155,187	155,114	100%

Table B6 continued.

Sub-basin (4th-Field)	5th-Field Watershed Name	HUC5	Total Acres in Watershed	Watershed acres within GPNF boundary	Percent of watershed acres within GPNF boundary	
UPPER COWLITZ	LOWER CISPUS RIVER	1708000405	123,522	114,974	93%	
COWLITZ	TILTON RIVER*	1708000501	103,138	42,685	41%	
COWLITZ	RIFFE RESERVOIR	1708000502	129,300	16,623	13%	
COWLITZ	NORTH FORK TOUTLE RIVER	1708000504	94,051	45,383	48%	
COWLITZ	GREEN RIVER	1708000505	84,158	27,047	32%	
COWLITZ	SOUTH FORK TOUTLE RIVER	1708000506	83,117	8,199	10%	
		Totals	**1,968,864**	**905,463**	**46%**	
Total acres/stream miles = gross estimates including inholdings w/in GPNF administrative boundary.						
Lake areas (i.e., Riffe Lake) are included in stream length estimates.						
This table was created using ArcGIS data.						
Lower Columbia River steelhead critical habitat is from NOAA-NMFS						
Critical habitat miles within the Tilton River drainage were proposed, but excluded in the final rule.						
Forest boundary is from GPNF GIS data.						
V.Harke, USFWS July 24, 2007 and October 2, 2007						

Table B7. GPNF weighted average percent below bankfull acres treated annually within fifth field watersheds under the EDRR program.

5th Field Watershed	Number of 6th Field subwatershed per 5th Field watershed	Total GPNF stream miles (all stream types)1	Total GPNF stream feet (all stream types)	Total GPNF stream area (sq. ft.)	Maximum annual below bankfull acres treated in 5th field watershed	Total GPNF stream acres	Average percent of total 5th field below bankfull acres treated annually
Wind River	8	1089	5749920	114998400	56	2640	2.12
Washougal River	3	116	612480	12249600	21	281	7.47
East Fork Lewis River	3	174	918720	18374400	21	422	4.98
Clearfork Cowlitz River	3	423	2233440	44668800	21	1025	2.05
Upper Cowlitz River	6	850	4488000	89760000	42	2061	2.04
Middle Cowlitz River	7	787	4155360	83107200	49	1908	2.57
Upper Cispus River	4	640	3379200	67584000	28	1552	1.80
Lower Cispus River	8	953	5031840	100636800	56	2310	2.42
Riffe Reservoir	1	103	543840	10876800	7	250	2.80
Tilton River	3	396	2090880	41817600	21	960	2.19
North Fork Toutle River	2	511	2698080	53961600	14	1239	1.13
Green River	2	241	1272480	25449600	14	584	2.40
South Fork Toutle River	1	77	406560	8131200	7	187	3.75
TOTAL	51	6360	33580800	671616000	357.000	15418	2.32

1 Harke, USFWS - October 15, 2007

1 mile =	5280	ft.
1 acre =	43560	sq. ft.

Instream channel area - Assume 20 ft. average channel width for all streams

PDC H14 limits treatment of emergent vegetation to 7 acreas/6th field HUC

Table B8. EDRR program predictions of number of future stream crossings, future stream crossings within 660 feet of an LCS stream, and future stream crossings directly over an LCS stream within the GPNF action area.

Predicted Future Stream Crossings – Assume that the difference between the total stream crossings in the GPNF entirely and the total stream crossings within treatment areas (TAs) equals the predicted future stream crossings.

What is known:

Total stream crossings within TAs:	1526
Total stream crossings in GPNF entirely.	7347

What is predicted:

Predicted potential EDRR program stream crossings:
7347 – 1526=5821

Predicted Future Stream Crossings within 660 feet of LCS Stream – Assume that the ratio of total stream crossings within 660 feet of an LCS stream per total stream crossings within the entire GPNF action area approximates the ratio of total stream crossings within 660 feet of an LCS stream per total stream crossings within the known TAs.

What is known:

Total stream crossings in known TAs:	1526
Total stream crossings within 660 feet of known TAs:	109

Ratio of total stream crossings within 660 feet of known TAs per total stream crossings in TAs: 109/1526=0.071

What is predicted:

Predicted potential number of EDRR program stream crossings: 5821

Predicted potential number of EDRR program stream crossings within 660 feet of an LCS streams: 5821*0.071=416

Predicted Future Stream Crossings Directly over LCS Streams – Assume that the ratio of total stream crossings directly over LCS streams per total stream crossings within the entire GPNF action area approximates the ratio of total stream crossings directly over LCS streams per total stream crossings within the known TAs:

What is known:

Total stream crossings in known TAs:	1526
Total stream crossings directly over LCS streams in known TAs:	25

Ratio of total stream crossings directly over LCS streams in TAs per total stream crossings in TAs: 25/1526=0.016

What is predicted:

Predicted potential EDRR program stream crossings: 5821

Predicted potential EDRR program stream crossings directly over LCS streams: 5821*0.016=95

Table B9. Summary of CRGNSA road miles and number of stream crossings within invasive plant treatment areas by fifth field watersheds within LCS and MCS habitat.

5th-Field Watershed Name	Total Road Miles on Federal Lands in Subwatershed	Treatment Area Road Miles located within 50 meters of Sthd streams	Total Road Miles Located Within Treatment Areas	Treatment Area Roads (miles) located within 660ft of Sthd CH streams	Total stream crossings located in Treatment Areas (all stream types)	Total stream crossings located within 660 ft of Sthd CH Streams in Treatment Areas (all stream types)	Steelhead ESU
WASHOUGAL RIVER	**1.40**	**0**	**0**	**0**	**0**	**0**	**LCS**
COLUMBIA GORGE TRIBUTARIES	7.64	0.05	0.14	0.14	0	0	LCS
COLUMBIA GORGE TRIBUTARIES	15.37	0.01	0.11	0	0	0	LCS
COLUMBIA GORGE TRIBUTARIES	6.79	0.16	0.34	0.16	2	2	LCS
COLUMBIA GORGE TRIBUTARIES	2.10	0	0.64	0	0	0	LCS
COLUMBIA GORGE TRIBUTARIES	**32**	**0.22**	1	**0**	**2**	**2**	**LCS**
MIDDLE COLUMBIA/ EAGLE CREEK	0.43	0	0	0	0	0	LCS
MIDDLE COLUMBIA/ EAGLE CREEK	1.71	0	0	0	0	0	LCS
MIDDLE COLUMBIA/ EAGLE CREEK	**2**	**0**	**0**	**0**	**0**	**0**	**LCS**
WIND RIVER	**18.62**	**0**	**0**	**0**	**0**	**0**	**LCS**
LITTLE WHITE SALMON RIVER	**0**	**0**	**0**	**0**	**0**	**0**	**MCS**
WHITE SALMON RIVER	0	0	0	0	0	0	MCS
WHITE SALMON RIVER	0	0	0	0	0	0	MCS
WHITE SALMON RIVER	**0**	**0**	**0**	**0**	**0**	**0**	**MCS**

Table B9 continued.

5th-Field Watershed Name	Total Road Miles on Federal Lands in Subwatershed	Treatment Area Road Miles located within 50 meters of Sthd streams	Total Road Miles Located Within Treatment Areas	Treatment Area Roads (miles) located within 660ft of Sthd CH streams	Total stream crossings located in Treatment Areas (all stream types)	Total stream crossings located within 660 ft of Sthd CH Streams in Treatment Areas (all stream types)	Steelhead ESU
MIDDLE COLUMBIA/ GRAYS CREEK	18.25	0	1.99	0	5	0	MCS
MIDDLE COLUMBIA/ GRAYS CREEK	10.18	0	0.55	0	0	0	MCS
MIDDLE COLUMBIA/ GRAYS CREEK	0.90	0	0	0	0	0	MCS
MIDDLE COLUMBIA/ GRAYS CREEK	**29**	**0**	**3**	**0**	**5**	**0**	**MCS**
LOWER KLICKITAT RIVER	0	0.04	2.06	1.69	20	20	MCS
LOWER KLICKITAT RIVER	0	0	0	0	0	0	MCS
LOWER KLICKITAT RIVER	**0**	**0.04**	**2**	**2**	**20**	**20**	**MCS**
MIDDLE COLUMBIA/MILL CREEK	0	0	0	0	0	0	MCS
MIDDLE COLUMBIA/MILL CREEK	0.99	0	0	0	0	0	MCS
MIDDLE COLUMBIA/MILL CREEK	**1**	**0**	**0**	**0**	**0**	**0**	**MCS**
UPPER MIDDLE COLUMBIA/HOOD	**0.25**	**0**	**0**	**0**	**0**	**0**	**MCS**
Total	**85**	**0.26**	**6**	**2**	**27**	**22**	
Sthd = steelhead, LCS = Lower Columbia River steelhead, MCS = Middle Columbia River steelhead							
All values are estimates derived from GIS data.							
This data does not include the Columbia River Shoreline							
Federal area estimates are based on available GIS data, which may be missing some Federal parcels.							
These estimates do not include non-federal lands within the Scenic Area boundary.							
Federal acres for the Klickitat and White Salmon watersheds are from Table 26 in the BA.							
Source: CRGNSA GIS Data							
Due to inherent inconsistencies in GIS analysis, the values represented here may differ from values presented elsewhere.							
V. Harke, USFWS 11/01/07							

Table B10. Summary of CRGNSA Treatments located within a 50 meter riparian buffer.

5th-Field Watershed Name	6th-Field Watershed Name	Total Treatment Acres in 6th field watershed	Treatment Acres Located within 50m riparian buffers (all stream types)	Percent of treatments within 50m riparian buffers	Treatment Acres Located within 50m of Sthd Streams	Treatment ID	Steelhead ESU
WASHOUGAL RIVER	**MIDDLE WASHOUGAL RIVER**	**0**	**0**	**0**	**0**	**na**	**LCS**
COLUMBIA GORGE TRIBUTARIES	TANNER CREEK	5.3	1.59	30.2%	1.59	22-04	LCS
COLUMBIA GORGE TRIBUTARIES	HAMILTON CREEK	30.5	0.02	0.1%	0.02	22-03	LCS
COLUMBIA GORGE TRIBUTARIES	VIENTO CREEK	42.8	14.55	34.0%	9.76	22-03	LCS
COLUMBIA GORGE TRIBUTARIES	LATOURELL CREEK	99.4	6.28	6.3%	0	na	LCS
5th-Field Total		**177.9**	**22.4**	**71%**	**11.4**		**LCS**
MIDDLE COLUMBIA/ EAGLE CREEK	ROCK CREEK	0	0	0	0	na	LCS
MIDDLE COLUMBIA/ EAGLE CREEK	CARSON CREEK	0	0	0	0	na	LCS
5th-Field Total		**0**	**0**	**0**	**0**		**LCS**
WIND RIVER	**LOWER WIND RIVER**	**0**	**0**	**0**	**0**	**na**	**LCS**
LITTLE WHITE SALMON RIVER	**LOWER LITTLE WHITE SALMON RIVER**	**0**	**0**	**0**	**0**	**na**	**MCS**
WHITE SALMON RIVER	LOWER WHITE SALMON RIVER	0	0	0	0	na	MCS
WHITE SALMON RIVER	MIDDLE WHITE SALMON RIVER	18.29	0.33	1.8%	0	22-15	MCS
5th-Field Total		**18.29**	**0.33**	**2%**	**0**		**MCS**
MIDDLE COLUMBIA/ GRAYS CREEK	GRAYS CREEK	295.9	71.82	24.3%	0	22-06	MCS

Table B10 continued.

5th-Field Watershed Name	6th-Field Watershed Name	Total Treatment Acres in 6th-field watershed	Treatment Acres Located within 50m riparian buffers (all stream types)	Percent of treatments within 50m riparian buffers	Treatment Acres Located within 50m of Sthd Streams	Treatment ID	Steelhead ESU
MIDDLE COLUMBIA/ GRAYS CREEK	ROWENA CREEK	86.40	7.68	8.9%	0	22-09, 22-10	MCS
MIDDLE COLUMBIA/ GRAYS CREEK	MAJOR CREEK	12.70	7.26	57.2%	0	22-09	MCS
5th-Field Total		**395.04**	**86.76**	**90%**	**0**		**MCS**
LOWER KLICKITAT RIVER	MOUTH OF KLICKITAT RIVER	156.80	54.42	34.7%	54.42	22-10, 22-16	MCS
LOWER KLICKITAT RIVER	SILVAS CREEK	0.02	0.02	100.0%	0	22-16	MCS
5th-Field Total		**156.82**	**54.44**	**135%**	**54.42**		**MCS**
MIDDLE COLUMBIA/ MILL CREEK	COLUMBIA RIVER/MURDOCK	0	0	0	0	na	MCS
MIDDLE COLUMBIA/ MILL CREEK	MIDDLE COLUMBIA/THREEMILE CREEK	28.58	6.33	22.2%	0	22-14, 22-13	MCS
5th-Field Total		**28.58**	**6.33**	**22%**	**0**		**MCS**
UPPER MIDDLE COLUMBIA/ HOOD	**MIDDLE COLUMBIA/HELLS GATE CANYON**	**339.58**	**0.00**	**0.0%**	**0.00**	**22-13**	**MCS**
	Totals	**1,116**	**170.30**	**15.3%**	**65.79**		

Sthd = steelhead, LCS = Lower Columbia River steelhead, MCS = Middle Columbia River steelhead
All values are estimates derived from GIS data.
This data does not include the Columbia River Shoreline
Federal area estimates are based on available GIS data, which may be missing some Federal parcels.
These estimates do not include non-federal lands within the Scenic Area boundary.
Federal acres for the Klickitat and White Salmon watersheds are from Table 26 in the BA.
Source: CRGNSA GIS Data
Due to inherent inconsistencies in GIS analysis, the values represented here may differ from values presented elsewhere.
V. Harke, USFWS 11/01/07

Table B11. Summary of Road Miles within Invasive Plant Treatment Areas within the CRGNSA.

5th-Field Watershed Name	HUC 6	6th-Field Watershed Name	Federal Subwatershed Acres within CRGNSA boundary	Total Road Miles on Federal Lands in Subwatershed	Total Road Miles Located Within Treatment Areas	Percent of Total Roads in Treatment Areas	Steelhead ESU
WASHOUGAL RIVER	170800010604	MIDDLE WASHOUGAL RIVER	147	1.40	0.00	0%	LCS
COLUMBIA GORGE TRIBUTARIES	170800010701	TANNER CREEK	1,657	7.64	0.14	2%	LCS
COLUMBIA GORGE TRIBUTARIES	170800010702	HAMILTON CREEK	4,469	15.37	0.11	1%	LCS
COLUMBIA GORGE TRIBUTARIES	170800010703	VIENTO CREEK	1,632	6.79	0.34	5%	LCS
COLUMBIA GORGE TRIBUTARIES	170800010704	LATOURELL CREEK	474	2.10	0.64	31%	LCS
MIDDLE COLUMBIA/EAGLE CREEK	170701051302	ROCK CREEK	72	0.43	0.00	0%	LCS
MIDDLE COLUMBIA/EAGLE CREEK	170701051304	CARSON CREEK	255	1.71	0.00	0%	LCS
WIND RIVER	170701051108	LOWER WIND RIVER	6,118	18.62	0.00	0%	LCS
LITTLE WHITE SALMON RIVER	170701051005	LOWER LITTLE WHITE SALMON RIVER	198	0.00	0.00	0%	MCS
WHITE SALMON RIVER	170701050911	LOWER WHITE SALMON RIVER	7	0.00	0.00	0%	MCS
WHITE SALMON RIVER	170701050908	MIDDLE WHITE SALMON RIVER	266	0.00	0.00	0%	MCS
MIDDLE COLUMBIA/ GRAYS CREEK	170701051203	GRAYS CREEK	6,757	18.25	1.99	11%	MCS

Table B11 continued.

5th-Field Watershed Name	HUC 6	6th-Field Watershed Name	Federal Subwatershed Acres within CRGNSA boundary	Total Road Miles on Federal Lands in Subwatershed	Total Road Miles Located Within Treatment Areas	Percent of Total Roads in Treatment Areas	Steelhead ESU
MIDDLE COLUMBIA/ GRAYS CREEK	170701051202	ROWENA CREEK	2,928	10.18	0.55	5%	MCS
MIDDLE COLUMBIA/ GRAYS CREEK	170701051201	MAJOR CREEK	771	0.90	0.00	0%	MCS
LOWER KLICKITAT RIVER	170701060408	MOUTH OF KLICKITAT RIVER	358	0.00	2.06	0%	MCS
LOWER KLICKITAT RIVER	170701060407	SILVAS CREEK	0	0.00	0.00	0%	MCS
MIDDLE COLUMBIA/ MILL CREEK	170701050406	COLUMBIA RIVER/MURDOCK	40	0.00	0.00	0%	MCS
MIDDLE COLUMBIA/ MILL CREEK	170701050404	MIDDLE COLUMBIA/ THREEMILE CREEK	871	0.99	0.00	0%	MCS
UPPER MIDDLE COLUMBIA/ HOOD	170701050103	MIDDLE COLUMBIA/ HELLS GATE CANYON	831	0.25	0.00	0%	MCS
		Totals	**27,852**	**85**	**6**	**54%**	

Sthd = steelhead, LCS = Lower Columbia River steelhead, MCS = Middle Columbia River steelhead
All values are estimates derived from GIS data.
This data does not include the Columbia River Shoreline
Federal area estimates are based on available GIS data, which may be missing some Federal parcels.
These estimates do not include non-federal lands within the Scenic Area boundary.
Federal acres for the Klickitat and White Salmon watersheds are from Table 26 in the BA.
Source: CRGNSA GIS Data
Due to inherent inconsistencies in GIS analysis, the values represented here may differ from values presented elsewhere.
V. Harke, USFWS 11/01/07

Table B12. Summary of CRGNSA watershed acres.

5th-Field Watershed Name	HUC 5	Total Acres in Subwatershed (WA)	Federal Watershed Acres within CRGNSA boundary	Percent of Watershed Acres on Federal Lands	Steelhead ESU
WASHOUGAL RIVER	1708000106	12,599	147	1.2%	LCS
COLUMBIA GORGE TRIBUTARIES	1708000107	14,706	1,657	11.3%	LCS
COLUMBIA GORGE TRIBUTARIES	1708000107	16,249	4,469	27.5%	LCS
COLUMBIA GORGE TRIBUTARIES	1708000107	4,988	1,632	32.7%	LCS
COLUMBIA GORGE TRIBUTARIES	1708000107	12,810	474	3.7%	LCS
MIDDLE COLUMBIA/ EAGLE CREEK	1707010513	10,619	72	0.7%	LCS
MIDDLE COLUMBIA/ EAGLE CREEK	1707010513	27,307	255	0.9%	LCS
WIND RIVER	1707010511	17,305	6,118	35.4%	LCS
LITTLE WHITE SALMON RIVER	1707010510	14,138	198	1.4%	MCS
WHITE SALMON RIVER	1707010509	17,307	7	0.0%	MCS
WHITE SALMON RIVER	1707010509	24,537	266	1.1%	MCS
MIDDLE COLUMBIA/ GRAYS CREEK	1707010512	12,444	6,757	54.3%	MCS
MIDDLE COLUMBIA/ GRAYS CREEK	1707010512	18,180	2,928	16.1%	MCS
MIDDLE COLUMBIA/ GRAYS CREEK	1707010512	20,098	771	3.8%	MCS

Table B12 continued.

5th-Field Watershed Name	HUC 5	Total Acres in Subwatershed (WA)	Federal Watershed Acres within CRGNSA boundary	Percent of Watershed Acres on Federal Lands	Steelhead ESU		
LOWER KLICKITAT RIVER	1707010604	32,018	358	1.1%	MCS		
LOWER KLICKITAT RIVER	1707010604	10,001	0	0.0%	MCS		
MIDDLE COLUMBIA/ MILL CREEK	1707010504	9,072	40	0.4%	MCS		
MIDDLE COLUMBIA/ MILL CREEK	1707010504	24,803	871	3.5%	MCS		
UPPER MIDDLE COLUMBIA/ HOOD	1707010501	16,660	831	5.0%	MCS		
	Totals	**315,838**	**27,852**	**8.8%**			

Sthd = steelhead, LCS = Lower Columbia River steelhead, MCS = Middle Columbia River steelhead
All values are estimates derived from GIS data.
This data does not include the Columbia River Shoreline
Federal area estimates are based on available GIS data, which may be missing some Federal parcels.
These estimates do not include non-federal lands within the Scenic Area boundary.
Federal acres for the Klickitat and White Salmon watersheds are from Table 26 in the BA.
Source: CRGNSA GIS Data
Due to inherent inconsistencies in GIS analysis, the values represented here may differ from values presented elsewhere.
V. Harke, USFWS 11/01/07

Table B 13. CRGNSA weighted average percent below bankfull acres treated annually within fifth field watersheds under the EDRR program.

5th-Field Watershed Name	Number of 6th Field subwatersheds per 5th Field watershed	Total Federal Lands stream miles (all stream types)1	Total Federal Land stream feet (all stream types)	Total Federal Land stream area (sq. ft.)	Maximum annual below bankfull acres treated within 5th field watershed	Total CRGNSA stream acres	Average percent of total 5th field below bankfull acres treated annually
WASHOUGAL RIVER	1	0.36	1900.8	38016	7	**0.87**	802.08
COLUMBIA GORGE TRIBUTARIES	4	38.77	204705.6	4094112	**28**	93.99	29.79
MIDDLE COLUMBIA/ EAGLE CREEK	2	1.93	10190.4	203808	14	**4.68**	299.22
WIND RIVER	1	57.87	305553.6	6111072	**7**	140.29	4.99
LITTLE WHITE SALMON RIVER	1	2.6	13728	274560	7	**6.30**	111.06
WHITE SALMON RIVER	2	0.08	422.4	8448	14	**0.19**	7218.75
MIDDLE COLUMBIA/ GRAYS CREEK	3	84.22	444681.6	8893632	**21**	204.17	10.29
LOWER KLICKITAT RIVER	2	0	0	0	14	0	0
MIDDLE COLUMBIA/ MILL CREEK	2	3.4	17952	359040	14	**8.24**	169.85
UPPER MIDDLE COLUMBIA/ HOOD	1	0	0	0	7	0	0
TOTAL	19	189.23	999134.4	19982688	133	458.74	28.99
1. V. Harke, USFWS 11/01/07							
1 mile =	5280	feet					
1 acre =	43560	sq. feet					
Instream channel area - Assume 20 ft. average channel width for all streams							
PDC H14 limits treatment of emergent vegetation to 7 acres/6th field HUC							
Bolded values identify the maximum allowed below bankfull acres treated within each							
fifth field watershed under the Incidental Take Statement of this Opinion.							

Table B14. EDRR program predictions of number of future stream crossings and future stream crossings within 660 feet of steelhead (LCS and MCS) streams within the CRGNSA action area.

Predicted Future Stream Crossings – Assume that the difference between the total streams crossings in the CRGNSA and the total stream crossings within the TAs equals the predicted future stream crossings.

What is known:

Total stream crossings within TAs: 27
Total stream crossings in CRGNSA entirely: 117

What is predicted:

Predicted potential EDRR program stream crossings:
117-27 = 90

Predicted Future Stream Crossings within 660 feet of a steelhead (LCS or MCS) Stream – Assume that the ratio of total stream crossings within 660 feet of a steelhead stream per total stream crossings within the CRGNSA action area approximates the ratio of total stream crossings within 660 feet of a steelhead stream per total stream crossings within the known TAs.

What is known:

Total stream crossings within TAs: 27
Total stream crossings within 660 feet of known TAs: 22
Ratio of total stream crossings within 660 feet of known TAs per total stream crossings in TAs: 22/27 = 0.81

What is predicted:

Predicted potential number of EDRR program stream crossings: 90

Predicted potential number of EDRR program stream crossings within 660 feet of steelhead streams: 90*0.81 = 72

Table B15. Treatment area estimates associated with GPNF and CRGNSA PDC H14 which limits above and below bankfull herbicide treatments within individual sixth field subwatersheds per year.

Stream Width (ft.)	Stream Length (ft.)	Area (sq.ft.)	Stream Acres
10	5,280	52,800	1.21
15	5,280	79,200	1.82
20	5,280	105,600	2.42
25	5,280	132,000	3.03
30	5,280	158,400	3.64
35	5,280	184,800	4.24
40	5,280	211,200	4.85
50	5,280	264,000	6.06
60	5,280	316,800	7.27
70	5,280	369,600	8.48
80	5,280	422,400	9.70
90	5,280	475,200	10.91
100	5,280	528,000	12.12

Stream Acres	Area (sq.ft.)	Stream Width (ft.)	Stream Length (ft.)	Stream length (miles)
7	304,920	10	30,492	5.78
7	304,920	15	20,328	3.85
7	304,920	20	15,246	2.89
7	304,920	25	12,197	2.31
7	304,920	30	10,164	1.93
7	304,920	35	8,712	1.65
7	304,920	40	7,623	1.44
7	304,920	50	6,098	1.16
7	304,920	60	5,082	0.96
7	304,920	70	4,356	0.83
7	304,920	80	3,812	0.72
7	304,920	90	3,388	0.64
7	304,920	100	3,049	0.58

1 acre =	43,560	sq. ft.
1 mile -	5,280	ft.

Aquatic Influence Zone = 150 ft.
1.5 miles = 7920 ft. x 150 ft = 27 acres of riparian area for each side of the stream or 54 acres along each 1.5 mile stream section.
10 acres represents about 18.5 percent of riparian area for each 1.5 mile of stream reach.

PDC H14:
Treatments above bankfull, within the aquatic influence zone, would not exceed 10 acres along any 1.5 mile of stream reach within a 6th field subwatershed in any given year.
Treatments below bankfull would not exceed 7 acres within a 6th field subwatershed in any given year.

V. Harke, USFWS June 4, 2007 modified by R. Friedman, NMFS November 6, 2007

Appendix C – HQ exceedance derivation tables

Table C1 – Small stream effects thresholds for four endpoints under soil types and rainfall levels.

			Fish	Inverts	Algae	Aq. Plants	Clay		Loam		Sand	
	App. Rate (pounds/acre)	Precipitation Rate	Effects Threshold (mg/l)				WCR	Wa Conc (mg/l)	WCR	Wa Conc (mg/l)	WCR	Wa Conc (mg/l)
Chlorsulfuron	Typical											
	0.056	15	2	89	0.01	0.0007	0.012	0.0007	0.0000	0.00000	0.0000	0.00000
		50	2	89	0.01	0.0007	0.113	0.0063	0.0004	0.00002	0.0130	0.00073
		100	2	89	0.01	0.0007	0.199	0.0111	0.0026	0.00015	0.0342	0.00191
		150	2	89	0.01	0.0007	0.202	0.0113	0.0043	0.00024	0.0449	0.00251
	Maximum											
	0.25	15	2	89	0.01	0.0007	0.012	0.0031	0.0000	0.00000	0.0000	0.00000
		50	2	89	0.01	0.0007	0.113	0.0282	0.0004	0.00010	0.0130	0.00325
		100	2	89	0.01	0.0007	0.199	0.0497	0.0026	0.00065	0.0342	0.00855
		150	2	89	0.01	0.0007	0.202	0.0505	0.0043	0.00107	0.0449	0.01122
Clopyralid	Typical											
	0.35	15	5	225	6.9	6.9	0.005	0.0016	0.0000	0.00000	0.0000	0.00000
		50	5	225	6.9	6.9	0.011	0.0037	0.0070	0.00245	0.0180	0.0063
		100	5	225	6.9	6.9	0.010	0.0038	0.0210	0.00736	0.0445	0.0156
		150	5	225	6.9	6.9	0.010	0.00353	0.0261	0.00913	0.0584	0.0204
	Maximum											
	0.5	15	5	225	6.9	6.9	0.005	0.0023	0.0000	0.00000	0.0000	0.00000
		50	5	225	6.9	6.9	0.011	0.0053	0.0070	0.00350	0.0180	0.0090
		100	5	225	6.9	6.9	0.010	0.0052	0.0210	0.01052	0.0445	0.0222
		150	5	225	6.9	6.9	0.010	0.00504	0.0261	0.01304	0.0584	0.0292
Glyphosate	Typical											
	2	15	0.1	37	2.1	48.4	0.0011	0.00225	0.0023	0.00468	0.0066	0.0133
		50	0.1	37	2.1	48.4	0.0181	0.03614	0.0281	0.05612	0.0566	0.1133
		100	0.1	37	2.1	48.4	0.0528	0.10556	0.0775	0.15495	0.1404	0.2809
		150	0.1	37	2.1	48.4	0.0924	0.18489	0.1323	0.26453	0.2271	0.4542
	Maximum											
	8	15	0.1	37	2.1	48.4	0.0011	0.00900	0.0023	0.01871	0.0066	0.0532
		50	0.1	37	2.1	48.4	0.0181	0.14454	0.0281	0.22447	0.0566	0.4531
		100	0.1	37	2.1	48.4	0.0528	0.42225	0.0775	0.61981	0.1404	1.1236
		150	0.1	37	2.1	48.4	0.0924	0.73957	0.1323	1.05811	0.2271	1.8166
Imazapyr	Typical											
	0.45	15	5	100	0.2	0.0228	0.00005	0.0000	0.00000	0.00000	0.0000	0.00000
		50	5	100	0.2	0.0228	0.0006	0.0003	0.00000	0.00000	0.0002	0.00007
		100	5	100	0.2	0.0228	0.0013	0.0006	0.00008	0.00004	0.0003	0.00014
		150	5	100	0.2	0.0228	0.002	0.0008	0.00011	0.00005	0.0004	0.00017
	Maximum											
	1.5	15	5	100	0.2	0.0228	0.00005	0.0001	0.00000	0.00000	0.0000	0.00000
		50	5	100	0.2	0.0228	0.0006	0.0009	0.00000	0.00000	0.0002	0.00024
		100	5	100	0.2	0.0228	0.0013	0.0019	0.00008	0.00012	0.0003	0.00047
		150	5	100	0.2	0.0228	0.002	0.0026	0.00011	0.00016	0.0004	0.00058
Metsulfuron	Typical											
	0.03	15	4.50	150	0.85	0.0002	0.0001	0.0000	0.00000	0.00000	0.0000	0.00000
		50	4.50	150	0.85	0.0002	0.0012	0.0000	0.00005	0.00000	0.0003	0.00001
		100	4.50	150	0.85	0.0002	0.0020	0.0001	0.00012	0.00000	0.0005	0.00002
		150	4.50	150	0.85	0.0002	0.0021	0.0001	0.00014	0.00000	0.0006	0.00002
	Maximum											
	0.15	15	4.50	150	0.85	0.0002	0.0001	0.0000	0.00000	0.00000	0.0000	0.00000
		50	4.50	150	0.85	0.0002	0.0012	0.0002	0.00005	0.00001	0.0003	0.00004
		100	4.50	150	0.85	0.0002	0.0020	0.0003	0.00012	0.00002	0.0005	0.00008
		150	4.50	150	0.85	0.0002	0.0021	0.0003	0.00014	0.00002	0.0006	0.00009
Sethoxydim	Typical											
	0.3	15	0.06	2.6	0.25	0.25	0.00462	0.00139	0.00147	0.0004	0.0198	0.0059
		50	0.06	2.6	0.25	0.25	0.05490	0.01647	0.1280	0.0384	0.0957	0.02871
		100	0.06	2.6	0.25	0.25	0.14100	0.04230	0.3060	0.0918	0.1740	0.05220
		150	0.06	2.6	0.25	0.25	0.229	0.08670	0.4060	0.1218	0.2260	0.06780
	Maximum											
	0.45	15	0.06	2.6	0.25	0.25	0.0046	0.00208	0.00147	0.0007	0.0198	0.0089
		50	0.06	2.6	0.25	0.25	0.0549	0.02471	0.1280	0.0576	0.0957	0.04307
		100	0.06	2.6	0.25	0.25	0.1410	0.06345	0.3060	0.1377	0.1740	0.07830
		150	0.06	2.6	0.25	0.25	0.2290	0.10305	0.4060	0.1827	0.2260	0.10170
Sulfometuron	Typical											
	0.03	15	4.5	12.5	0.0046	0.0075	0.0001	0.0000	0.00000	0.00000	0.0000	0.00000
		50	4.5	12.5	0.0046	0.0075	0.0008	0.0000	0.00000	0.00000	0.0001	0.00000
		100	4.5	12.5	0.0046	0.0075	0.0016	0.0000	0.00004	0.00000	0.0003	0.00001
		150	4.5	12.5	0.0046	0.0075	0.0021	0.0001	0.00005	0.00000	0.0003	0.00001
	Maximum											
	0.38	15	4.5	12.5	0.0046	0.0075	0.0001	0.0000	0.0000	0.00000	0.0000	0.00000
		50	4.5	12.5	0.0046	0.0075	0.0008	0.0003	0.0000	0.00000	0.0001	0.00005
		100	4.5	12.5	0.0046	0.0075	0.0016	0.0006	0.0000	0.00002	0.0003	0.00010
		150	4.5	12.5	0.0046	0.0075	0.0021	0.0008	0.0000	0.00002	0.0003	0.00013
Imazapic	Typical											
	0.1	15	5	100	0.05	0.0061	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
		50	5	100	0.05	0.0061	0.0005	0.0000	0.0000	0.00000	0.0001	0.00000
		100	5	100	0.05	0.0061	0.0010	0.0000	0.0001	0.00000	0.0002	0.00000
		150	5	100	0.05	0.0061	0.0014	0.0000	0.0001	0.00000	0.0003	0.00000
	Maximum											
	0.1875	15	5	100	0.05	0.0061	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
		50	5	100	0.05	0.0061	0.0005	0.0000	0.0000	0.00000	0.0001	0.00000
		100	5	100	0.05	0.0061	0.0010	0.0000	0.0001	0.00000	0.0002	0.00000
		150	5	100	0.05	0.0061	0.0014	0.0000	0.0001	0.00000	0.0003	0.00000
Picloram	Typical											
	0.35	15	0.04	68.30	0.94	164	0.0102	0.0036	0.0000	0.00000	0.0194	0.00678
		50	0.04	68.30	0.94	164	0.0980	0.0000	0.0116	0.00000	0.0482	0.00000
		100	0.04	68.30	0.94	164	0.1840	0.0000	0.0165	0.00000	0.0680	0.00000
		150	0.04	68.30	0.94	164	0.1871	0.0000	0.0179	0.00000	0.0745	0.00000
	Maximum											
	1	15	0.04	68.30	0.94	164	0.0102	0.0102	0.0000	0.00000	0.0194	0.01936
		50	0.04	68.30	0.94	164	0.0980	0.0000	0.0116	0.00000	0.0482	0.00000
		100	0.04	68.30	0.94	164	0.1840	0.0000	0.0165	0.00000	0.0680	0.00000
		150	0.04	68.30	0.94	164	0.1871	0.0000	0.0179	0.00000	0.0745	0.00000
Triclopyr	Typical											
	1	15	0.26	133	5.9	8.8	0.0166	0.0166	0.0184	0.01838	0.0167	0.01675
		50	0.26	133	5.9	8.8	0.1254	0.0000	0.0940	0.00000	0.0548	0.00000
		100	0.26	133	5.9	8.8	0.2441	0.0000	0.1687	0.00000	0.0878	0.00000
		150	0.26	133	5.9	8.8	0.3169	0.0000	0.2221	0.00000	0.1145	0.00000
	Maximum											
	10	15	0.26	133	5.9	8.8	0.0166	0.1657	0.0184	0.18383	0.0167	0.16746
		50	0.26	133	5.9	8.8	0.1254	0.0000	0.0940	0.00000	0.0548	0.00000
		100	0.26	133	5.9	8.8	0.2441	0.0000	0.1687	0.00000	0.0878	0.00000
		150	0.26	133	5.9	8.8	0.3169	0.0000	0.2221	0.00000	0.1145	0.00000

Table C2- Floodplain wedge analysis.

Floodplain Wedge Analysis for One Acre Site

General Formula: (# lbs a.i./acre X mg/lb conversion) / (flow in cubic meters/second X cu. meter to liter conversion X # seconds of application) = mg/l

Glyphosate

Application amount (lbs/acre converted to mg) — Max. concentrations in a floodplain wedge, at 0.25 cu.m/s (8.8 cfs), and 1.0 cu.m/s (35.3 cfs)

0.5 lbs/acre	226796 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.13
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.03
2 lbs/acre	907185 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.50
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.13
8 lbs/acre	3628738 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	2.02
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.50

Imazapyr

Application amount (lbs/acre converted to mg) — Max. concentrations in a floodplain wedge, at 0.25 cu.m/s (8.8 cfs), and 1.0 cu.m/s (35.3 cfs)

0.45 lbs/acre	204117 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.11
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.03
1.5 lbs/acre	680388 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.38
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.09

Triclopyr

Application amount (lbs/acre converted to mg) — Max. concentrations in a floodplain wedge, at 0.25 cu.m/s (8.8 cfs), and 1.0 cu.m/s (35.3 cfs)

0.1 lbs/acre	45359 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.03
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.01
1 lbs/acre	453592 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.25
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.06
6 lbs/acre	2721554 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	1.51
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.38

Table C3 – Microsite analysis.

Micro-site Analysis

1 pound per acre in 1 cu ft of water = 0.368 mg/l, which = 368 ug/l

General Formula: ((lbs/acre X mg/lb)/(sq.ft/acre))/(l/cu.ft) = mg/l

Results in mg/l in a sq.ft of 1 foot deep floodplain area.

Columns below are for emergent vegetation rain rinse (in mg/l)

Glyphosate

lbs/acre	mg/lb	mg/acre	mg/sq.ft	mg/l (per cf)	* concentration in 1' from rinse	** concentration in 4" from rinse	*** Emergent overspray
0.5	453592	226796	5.207	0.184	0.069	0.21	0.05
2	453592	907184	20.826	0.735	0.28	0.83	0.18
8	453592	3628736	83.304	2.942	1.1	3.31	0.7

Imazapyr

lbs/acre	mg/lb	mg/acre	mg/sq.ft	mg/l (per cf)	* concentration in 1' from rinse	** concentration in 4" from rinse	*** Emergent overspray
0.45	453592	204116.4	4.686	0.165	0.11		0.04
1.5	453592	680388	15.620	0.552	0.37		0.14

Triclopyr

lbs/acre	mg/lb	mg/acre	mg/sq.ft	mg/l (per cf)	* concentration in 1' from rinse	** concentration in 4" from rinse	*** Emergent overspray
0.1	453592	45359	1.041	0.037	0.026	0.079	0.009
1	453592	453592	10.413	0.368	0.26	0.79	0.09
10	453592	4535920	104.130	3.677	2.6	7.9	0.92

* formula is (mg/l per cu.ft) * wash-off fraction * (1 - 0.25); where (1 - 0.25) is the amount on emergent plant (25% was considered overspray)

** J cell number X 3

*** E cell (total 1' conc) - J cell (conc from rinse fraction)
Represents the concentration in 1' of water from 25% overspray

Appendix D – Toxicity Indices for Listed Fish from the Biological Assessment

Indices represent the most sensitive endpoint from the most sensitive species for which adequate data are available. Numbers in red indicate the toxicity index used in calculating the hazard quotient for exposures to listed fish. Generally, the lowest toxicity index available for the species most sensitive to effects was used. Measured chronic data (NOEC) was used when they were lower than $1/20^{th}$ of an acute LC50 because they account for at least some sublethal effects, and doses that are protective in chronic exposures are more certain to be protective in acute exposures.

Herbicide	Duration	Endpoint	Dose	Species	Effect Noted at LOAEL
Chlorsulfuron	Acute	NOEC	**2 mg/L** (1/20th of LC50)	Brown trout	LC50 at 40 mg/L
	Chronic	NOEC[1]	3.2 mg/L	Brown trout	rainbow trout length affected at 66mg/L
Clopyralid	Acute	NOEC	**5 mg/L** ($1/20^{th}$ of LC50)	Rainbow trout	LC50 at 103 mg/L
	Chronic				none available
Glyphosate (no surfactant)	Acute	NOEC	**0.5 mg/L** ($1/20^{th}$/LC50)	Rainbow trout	LC50 at 10 mg/L
	Chronic	NOEC	2.57 mg/L[2]	Rainbow trout	Life-cycle study in minnows; LOAEL not given
Glyphosate with POEA surfactant	Acute	NOEC	**0.065 mg/L** ($1/20^{th}$ of LC50)	Rainbow trout	LC50 at 1.3 mg/L for fingerlings (surfactant formulation)
	Chronic	NOEC	0.36 mg/L	salmonids	estimated from full life-cycle study of minnows (surfactant formulation)
Imazapic	Acute	NOEC	100 mg/L	all fish	at 100 mg/L, no statistically sig. mortality
	Chronic	NOEC	**100 mg/L**	fathead minnow	No treatment related effects on hatch or growth
Imazapyr	Acute	NOEC	**5 mg/L** ($1/20^{th}$ LC50)	trout, catfish, bluegill	LC50 at 110-180 mg/L for North American species
	Chronic	NOEC	43.1 mg/L	Rainbow	"nearly significant" effects on early life stages at 92.4 mg/L
Metsulfuron methyl	Acute	NOEC	10 mg/L	Rainbow	lethargy, erratic swimming at 100 mg/L
	Chronic	NOEC	**4.5 mg/L**	Rainbow	standard length effects at 8 mg/L
Picloram	Acute	NOEC	**0.04 mg/L** ($1/20^{th}$ LC50)	Cutthroat trout	LC50 at 0.80 mg/L
	Chronic	NOEC	0.55 mg/L	Rainbow trout	body weigh and length of fry reduced at 0.88 mg/L
Sethoxydim	Acute	NOEC	**0.06 mg/L** ($1/20^{th}$ LC50)	Rainbow trout	LC50 of Poast at 1.2 mg/L
	Chronic	NOEC			none available
Sulfometuron methyl	Acute	NOEC	7.3 mg/L	Fathead minnow	No signs of toxicity at highest doses tested

Indices represent the most sensitive endpoint from the most sensitive species for which adequate data are available. Numbers in red indicate the toxicity index used in calculating the hazard quotient for exposures to listed fish. Generally, the lowest toxicity index available for the species most sensitive to effects was used. Measured chronic data (NOEC) was used when they were lower than 1/20th of an acute LC50 because they account for at least some sublethal effects, and doses that are protective in chronic exposures are more certain to be protective in acute exposures.

Herbicide	Duration	Endpoint	Dose	Species	Effect Noted at LOAEL
	Chronic	NOEC	**1.17 mg/L**	Fathead minnow	No effects on hatch, survival or growth at highest doses tested
Triclopyr acid	Acute	NOEC	**0.26 mg/L** (1/20th LC50)	Chum salmon	LC50 at 5.3 mg/L[3]
	Chronic	NOEC	104 mg/L	Fathead minnow	Reduced survival of embryo/larval stages at 140 mg/L
Triclopyr BEE	Acute		**0.012 mg/L**	Bluegill sunfish	LC50 at 0.25 mg/L
	Chronic[4]	NOEC	104 mg/L	Fathead minnow	Reduced survival of embryo/larval stages at 140 mg/L
NPE Surfactants	Acute[5]	NOEC	**0.2 mg/L** (1/20th LC50)	fathead minnow, rainbow trout	LC50 at 4.0 mg/L
	Chronic[6]	NOEC	1.0 mg/L	trout	no LOEL given

1 Chronic value for brown trout (sensitive sp.) was estimated using relative potency in acute and chronic values for rainbow trout, and the acute value for brown trout.
2 Estimated from minnow chronic NOEC using the relative potency factor method (SERA 2003a).
3 Using Wan et al. (1989) value for lethal dose.
4 Chronic and subchronic data for triclopyr are limited to triclopyr TEA. No data is available for triclopyr BEE.
5 Exposure includes small percentage of NP and NP1-2E (Bakke, 2003).
6 Chronic exposure is from degredates NP1EC and NP2EC, because NPE breaks down rapidly and NPEC's are more persistent (Bakke, 2003).