United States Department of Agriculture

Forest Service

Pacific Northwest Region

Olympic National Forest Final Environmental Impact Statement And Record of Decision

Beyond Prevention: Site-Specific Invasive Plant Treatment Project

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Clallam, Grays Harbor, Jefferson, and Mason Counties in the State of Washington

Final Environmental Impact Statement
Site-Specific Invasive Plant Treatment Project

Clallam, Grays Harbor, Jefferson and Mason Counties, State of Washington

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Abstract

This Final Environmental Impact Statement (FEIS) discloses the effects of treating invasive plants on the Olympic National Forest. Invasive species were identified by the Chief of the Forest Service as one of the four threats to forest health (for more information see http://www.fs.fed.us/projects/four-threats). Invasive plants are displacing native plants, destabilizing streams, reducing the quality of fish and wildlife habitat; and degrading natural areas. While invasive plant prevention is an integral part of the invasive plant program, the focus of this Final Environmental Impact Statement (FEIS) is on the part of the program that has a need for action beyond prevention.

Strong public concern has been expressed regarding Forest Service response (or lack of response) to invasive plants. Several organizations and individuals have offered to cooperate with the Forest Service in this endeavor. The Forest Service is responding to a crucial need for timely containment, control, and/or eradication of invasive plants, including those that are currently known and those discovered in the future. The purpose of this project is to treat invasive plants in a cost-effective manner that complies with environmental standards.

Approximately 3,830 acres of infestation have been inventoried, including but not limited to herb Robert, knapweeds, hawkweeds, knotweeds, and reed canary grass. This Final Environmental Impact Statement includes detailed consideration of four alternatives to address these infestations.

No Action (also referred to as Alternative A) would implement treatments according to existing plans; no new invasive plant treatments would be approved. The Proposed Action (also referred to as Alternative B) would apply an initial prescription, along with re-treatment in subsequent years, until the site was restored with desirable vegetation. Herbicide treatments would be part of the initial prescription for most sites, but the use of herbicides would be expected to decline in subsequent entries as populations became small enough to treat manually or mechanically.

Ongoing inventories would confirm the location of specific invasive plants and effectiveness of past treatments. Treatment prescriptions would be strict enough to ensure that adverse effects are minimized, while flexible enough to adapt to changing conditions over time.

Alternative B would allow invasive plant treatments in all land allocations, including wilderness and riparian reserves, across the National Forest. Project design features for the Proposed Action restrict certain treatment methods depending on the land allocation and other site conditions such as proximity to surface water bodies, wildlife habitats, botanical species of local interest, etc.

Two action alternatives were developed in response to public issues related to herbicide use. Alternative C resolves most concerns related to herbicide use by eliminating herbicide application on about two-thirds of the National Forest System lands. Under Alternative C, only very limited herbicide use would be permitted within riparian reserves and road drainage ditch networks. Alternative C would minimize herbicide impacts, but would increase treatment costs and decrease treatment effectiveness.

Alternative D was developed to increase treatment flexibility by approving broadcast treatments in more situations than the Proposed Action. Alternative D reduces the costs of treatments, but under worst-case conditions, herbicides could enter streams and other water bodies and harm aquatic organisms.

The Forest Service Preferred Alternative is the Proposed Action (Alternative B). The Proposed Action has been modified in response to public and interagency comments.

Cover photo: Knotweed growing near Lake Quinault, Olympic National Forest. Knotweed is an invasive plant often used in landscaping. Once established, knotweed can out-compete native vegetation with serious adverse impacts to the environment.

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

Final Environmental Impact Statement
Olympic National Forest
Beyond Prevention: Site-Specific Invasive Plant Treatment Project

Summary

Land managers for the Olympic National Forest propose to treat invasive plants via a combination of manual, mechanical, and herbicide methods and site restoration (seeding/mulching/planting). Invasive species were identified by the Chief of the Forest Service as one of the four threats to forest health (for more information see http://www.fs.fed.us/projects/four-threats). Invasive plants are displacing native plants and degrading natural areas, potentially destabilizing streams and reducing the quality of fish and wildlife habitat. Our integrated invasive plant management program includes a) herbicide and non-herbicide treatment of existing infestations, b) early detection and rapid response to new infestations, c) restoration of treated sites, d) reducing the rate of spread of invasives through adopting prevention practices, and e) interagency and public education and coordination. The focus of this Final Environmental Impact Statement (FEIS) is on the part of our program related to treatment and restoration of invasive plant sites.

New invasive plant management direction has recently been approved by the Pacific Northwest (R6) Regional Forester, allowing for a wider range of herbicide options and specific treatment and restoration standards (USDA 2005b, the *Pacific Northwest Invasive Plant Program Record of Decision*, referred to herein as the R6 2005 ROD).

The purpose of this project is to control invasive plants in a cost-effective manner that complies with the new management direction. Proposed treatment methods include a limited amount of herbicide broadcast along roadsides, and spot and selective herbicide applications that target individual invasive plants in combination with manual, mechanical and restoration treatments.

With this project, the Forest Service is responding to a need for timely containment, control, and/or eradication of invasive plants, including those that are currently known and those discovered in the future. Approximately 3,830 acres are currently estimated to need treatment, including but not limited to herb Robert, knapweeds, hawkweeds, knotweeds, and reed canary grass. Under the Proposed Action (also referred to as Alternative B), infested areas would be treated with an initial prescription and retreated in subsequent years until the site was restored with desirable vegetation. Herbicide treatments would be part of the initial prescription for most sites; however, use of herbicides would be expected to decline in subsequent entries. Ongoing inventories would confirm the location of specific invasive plants and effectiveness of past treatments. Treatment prescriptions would be strict enough to ensure that adverse effects are minimized, while flexible enough to adapt to changing conditions over time.

This FEIS has been prepared to consider the site-specific environmental consequences of treating invasive plants over the next 5 to 15 years (until invasive plant objectives are met or until changed conditions or new information warrants the need for a new decision). This EIS is tiered to a broader scale analysis (the *Pacific Northwest Region Invasive Plant Program Final Environmental Impact Statement*, USDA 2005a, hereby referred to as the R6 2005 FEIS).

The R6 2005 FEIS culminated in a Record of Decision (USDA 2005b, hereby referred to as the R6 2005 ROD), which added management direction relative to invasive plants to the Olympic National Forest Plan. The management direction applied to the broader Forest invasive plant program, establishing goals, objectives and standards for public education and coordination, prevention of the spread of invasive plants during land uses and activities, reducing reliance on herbicides over time, and treatment and restoration.

This project level EIS is focused on issues related to treatment and minimizing the adverse effects of treatment. In total, four alternatives are considered, including No Action (also referred to as Alternative A), the Proposed Action (also referred to as Alternative B), and two action alternatives (Alternatives C and D).

Under No Action (Alternative A), no new treatments would be implemented, beyond those previously approved. The Proposed Action (Alternative B) is the Preferred Alternative. Under Alternative B, known infestations of invasive plants could conceivably be controlled within five years (assuming an unlimited funding level which is at least five times greater than current projections). Control would take longer (30 years) given a more likely and sustainable funding level, with lower priority areas unlikely to be treated. Alternative B minimizes environmental and human health risks through adherence to Project Design Features that abate herbicide and site-specific hazards.

Two action alternatives were developed in response to public issues related to herbicide use (Alternatives C and D). Alternative C resolves most concerns related to herbicide use by eliminating herbicide application on about two-thirds of the National Forest System lands. Alternative D was developed to increase treatment flexibility and reduce costs.

Under Alternative C, very limited herbicide use[1] would be permitted within Riparian Reserves. No herbicides would be used within roadside treatment areas with high potential to deliver herbicides. Alternative C would minimize herbicide impacts by virtually eliminating herbicide delivery mechanisms to surface water bodies, but would increase treatment costs and decrease treatment effectiveness.

Alternative D was developed to increase treatment flexibility by approving broadcast treatments in more situations than the Proposed Action. Alternative D reduces the costs of treatments, but under worst-case conditions, herbicides could enter streams and other water bodies and harm aquatic organisms.

The Proposed Action (Alternative B) is the Preferred Alternative. Although Alternative B assumes more risk to non-target organisms, water quality, wildlife and fish from herbicide use than Alternative C, the increased risks are small compared to the benefits. Alternative B is predicted to cost about five percent more to implement than Alternative D, but otherwise is similarly effective. This cost savings is small, especially compared to the additional risk associated with broadcast treatments near intermittent streams and ditches that would be allowed in Alternative D.

Chapter 1 of this project level EIS describes the purpose and need for action, the decision to be made, a brief outline of the proposed action, the public involvement process, and key public issues. Chapter 2 describes and compares the four alternatives considered in detail. Chapter 3 provides the analytical basis for the alternative comparison in Chapter 2. Substantive changes made to the Proposed Action and analysis between the Draft and Final EIS are identified throughout the documents.

The Draft EIS contained several appendices that did not changes between the Draft and Final EIS and are not reproduced in the printed copy of the FEIS (Appendix B, D, E, F and G). These are on the cd version of the FEIS and are available on the project website (find link at http://www.fs.fed.us/r6/olympic).

[1] Existing agreements allow for the use of aquatic-labeled glyphosate within streams to treat knotweed.

Chapter 1. Purpose of and Need for Action

1.1 Introduction

Land managers for the Olympic National Forest propose to treat invasive plants over the next five to fifteen years via a combination of manual, mechanical, and herbicide methods and site restoration. This Environmental Impact Statement (EIS) has been prepared to consider the site-specific environmental consequences of taking this action. The main body of the EIS is organized into four chapters:

- *Chapter 1. Purpose and Need for Action:* The chapter includes information on the background and purpose of and need for the project. This section also details how the Forest Service informed the public of the proposal and the issues identified through public scoping.
- *Chapter 2. Alternatives, including the Proposed Action:* This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for meeting the need for action. These alternatives were developed based on issues raised by the public and other agencies. This section provides a summary table of the design components that compares the relative risks and benefits of each alternative.
- *Chapter 3. Affected Environment and Environmental Consequences*: This chapter describes the current situation and the resources that are at risk from invasive plants on the Olympic National Forest. It also details the environmental effects of implementing the Proposed Action and other alternatives.
- *Chapter 4. Consultation and Coordination:* This chapter provides a list of preparers and agencies and people consulted during the development of the environmental impact statement.

This FEIS summarizes specialist input and analysis completed for botany, hydrology, fisheries, soils, wildlife, and heritage resources, as well as for cost effectiveness and effects to human health. The analysis files contain records of interagency and public correspondence, including documents related to Section 7 Endangered Species Act Consultation with National Marine Fisheries Service (NMFS or NOAA Fisheries) and the United States Fish and Wildlife Service (USFWS or FWS).

This FEIS is tiered to the broader scale *Pacific Northwest Region Invasive Plant Program Final Environmental Impact Statement* (USDA 2005a, referred to herein as the R6 2005 FEIS). Agencies are encouraged to tier their environmental impact statements to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision at each level of environmental review (36 CFR 1508.28). As required, this "subsequent statement" summarizes issues discussed in the broader statement (R6 2005 FEIS) and concentrates on site-specific issues. The R6 2005 FEIS incorporated the best available scientific information from herbicide risk assessments and other reliable scientific sources.

The R6 2005 FEIS culminated in a Record of Decision (R6 2005 ROD) that amended the Olympic National Forest Plan by adding management direction relative to preventing and treating invasive plants. This project is intended to comply with the new management direction. Despite our best efforts at prevention (see Appendix G), invasive plants currently grow, and without treatment will continue to spread.

1.1.1 Changes between Draft and Final EIS

The Proposed Action was modified and analysis was added in response to public and interagency comments since the release of the Draft EIS (see Appendix H for DEIS Comments and Responses).

Modifications to the Proposed Action are described in Chapter 2. Additional analysis is identified in each section of Chapter 3. Appendix H also summarizes the changes made in response to public and interagency comment.

1.2 Project Area

The project area is the entire Olympic National Forest (see vicinity map). The Forest comprises 632,300 acres of the Olympic Peninsula, the northwestern-most portion of land in the Continental United States.

1.3 Proposed Action

Under the Proposed Action, site-specific treatments prescriptions would be implemented over the next three to fifteen years, based on Common Control Measures (see Table 10 and Appendix B) and Project Design Features (see Table 12). A variety of target species would be treated including but not limited to knapweed, knotweed, hawkweed, and reed canarygrass.

Prescriptions would vary depending on the values at risk from invasive species; the biology of particular invasive plant species, the proximity to water and other sensitive resources, and the size of the infestation (these factors may change over time).

The Proposed Action would be implemented over several years as funding allows, until treatments were no longer needed or until conditions otherwise changed sufficiently to warrant this EIS outdated. Site-specific conditions are expected to change within the life of the project, without necessitating further analysis; for instance, treated infestations would be reduced in size, untreated infestations would continue to spread and/or new invasive plants could become established within the project area. The effects analysis considers a range of treatments applied to a range of site conditions to accommodate the uncertainty associated with the project implementation schedule. Treatment prescriptions would be strict enough to ensure that adverse effects are minimized, while flexible enough to adapt to changing conditions.

The Proposed Action would allow for treatment of infestations that are not currently inventoried, even those found outside mapped treatment areas (see Appendix A). An Implementation Planning process would be applied to new infestations to ensure that treatments are within the scope of the analysis and eventual decision. Project Design Features were developed to minimize the potential for adverse effects no matter how many acres may be selected for treatment in a given season.

Infested areas would be treated with an initial prescription, and retreated in subsequent years, depending on the results, until control objectives were met. Many variables could affect invasive plant treatments, including treatment effectiveness, timing, weather, soil type, conditions on neighboring non-federal lands, and available funding and personnel.

The Proposed Action would allow invasive plant treatments in all land allocations, including wilderness and riparian reserves, across the National Forest. Project design features for the Proposed Action restrict certain treatment methods depending on the land allocation and other site conditions such as proximity to surface water bodies, wildlife habitats, botanical species of local interest, etc.

Herbicide treatments are part of the initial prescription for most sites; however, use of herbicides would be expected to decline in subsequent entries (see section 3.1.4)

A decision to implement the Proposed Action (or action alternative) would replace the management direction provided in the *Environmental Assessment for the Integrated Weed Management Program, Olympic National Forest* (USDA Forest Service, 1998).

For a full description of the Proposed Action (also referred to as Alternative B), see Chapter 2.

1.4 Purpose and Need for Action

Invasive species were identified by the Chief of the Forest Service as one of the four threats to forest health (for more information see http://www.fs.fed.us/projects/four-threats). Invasive plants are adversely impacting approximately 3,830 acres, scattered across the Olympic National Forest. Invasive plants are displacing native plants, destabilizing streams, reducing the quality of fish and wildlife habitat; and degrading natural areas on the Olympic National Forest. Strong public concern has been expressed regarding Forest Service response (or lack of response) to invasive plants. Several organizations and individuals have offered to cooperate with the Forest Service in this endeavor. The Forest Service is responding to the crucial need for timely containment, control, and/or eradication of invasive plants, including those that are currently known and those discovered in the future. The purpose of this project is to treat invasive plants in a cost-effective manner that complies with environmental standards.

The R6 2005 ROD added the following Desired Future Condition Statement to the Olympic National Forest Plan:

> …Healthy native plant communities remain diverse and resilient, and damaged ecosystems are being restored. High quality habitat is provided for native organisms throughout the [Forest]. Invasive plants do not jeopardize the ability of [the Olympic] National Forest to provide goods and services communities expect. The need for invasive plant treatment is reduced due to the effectiveness and habitual nature of preventative actions, and the success of restoration efforts.

Habitat for native plant communities has been degraded in or near special places such as the Colonel Bob, Mount Skohomish and Buckhorn Wilderness Areas; Matheny Pond, Matheny Prairie, Bill's Bog, and Cranberry Bog Botanical Areas; Quinault and Wet Weather Creek Research Natural Areas, Quinault and Crescent Lakes; and a host of trails, campgrounds, and other popular recreation areas. These areas require action to restore native plant communities.

Without treatment, invasive plants will continue to spread within these and other special areas on and adjacent to the National Forest. Invasive plants on National Forest System lands also have the potential to spread to neighboring lands including the Olympic National Park, Native American tribal lands, state and private properties. Chapter 3 details site-specific values at risk from invasive plants, and describes places where invasive plants are most likely to spread to neighboring lands. Invasive plants are currently spreading at a rate of 8 to 12 percent annually (R6 2005 FEIS).

Vicinity Map (vicinity.pdf)

Not all invasive plants are equally threatening to environmental and social values; priority for treatment and treatment strategy[2] varies depending on the biology of the invasive species, size of the infestation, and the values at risk from the infestation now and in the future.

Treatment intensity and restoration requirements are highly variable. As a result, the need for action is multi-faceted and more complex than simply "killing weeds."

The R6 2005 ROD provided an updated approach to invasive plant management, including standards for preventing invasive plants and using new herbicides. While invasive plant prevention is an integral part of the invasive plant program, the focus of this FEIS is on the part of the program that has a need for action beyond prevention. The R6 2005 FEIS found that prevention practices alone will not result in reaching invasive plant program goals and objectives (see table 1). The proposed treatment/restoration prescriptions include a combination of herbicide and non-herbicide methods; however, key public issues are primarily related to the use of herbicides.

Invasive plant spread is unpredictable and actual locations of target species may change abruptly over time. Thus, the Forest Service needs the flexibility to adapt to changing conditions, and rapidly respond to invasive plant threats that may be currently unknown. Timeliness of action is an important factor because the cost, difficulty, and potential adverse effects of controlling invasive plants increases with the size and extent of the population. The smaller the population is when treated, the more likely the treatment will be effective. Timely treatments are also important to help meet the Forest Plan objective of reduced herbicide use over time.

1.4.1 Regulatory Basis for Project/Environmental Standards

Several broad federal policies require the control of invasive plants. Executive Order 13112 (1999) directs federal agencies to reduce the spread of invasive plants. The Forest Service Pesticide Use Handbook (FSH 2109.14) provides agency guidance on planning, implementation, and reporting of projects that include herbicide (see Appendix E for more information).

The R6 2005 ROD added invasive plant management direction (displayed in tables 1 and 2) to the existing direction for the Olympic National Forest Plan (displayed in table 3). Land uses and activities, including invasive plant treatments, would be designed to comply with the R6 2005 ROD standards. Standards for preventing invasive plants are in Appendix G.

[2] Definitions of these treatment strategies are adapted from the 2005 R6 FEIS. Two additional objectives (tolerate and suppress) are also discussed in the 2005 R6 FEIS. Invasive plants with these objectives would not be treated using the methods described in this EIS.
Eradicate: Totally eliminate an invasive plant species from a site. This strategy generally applies to the hardest to control invasive species and highest-valued sites over about 11 percent of the infested acreage.
Control: Reduce the acreage of the infestation over time. This strategy applies to about 39 percent of the project area.
Contain: No increase in acreage infested. This objective applies to about 50 percent of the infested acreage.
Priority is further discussed in Chapter 2.

Table 1-Goals and Objectives from the R6 2005 ROD

Invasive Plants Treatment Goals and Objectives from the R6 2005 ROD	
Goal 1 - Protect ecosystems from the impacts of invasive plants through an integrated approach that emphasizes prevention, early detection, and early treatment. All employees and users of the National Forest recognize that they play an important role in preventing and detecting invasive plants.	
Objective 1.1	Implement appropriate invasive plant prevention practices to help reduce the introduction, establishment and spread of invasive plants associated with management actions and land use activities.
Objective 1.2	Educate the workforce and the public to help identify, report, and prevent invasive plants.
Objective 1.3	Detect new infestations of invasive plants promptly by creating and maintaining complete, up-to-date inventories of infested areas, and proactively identifying and inspecting susceptible areas not infested with invasive plants.
Objective 1.4	Use an integrated approach to treating areas infested with invasive plants. Utilize a combination of available tools including manual, cultural, mechanical, herbicides, biological control.
Objective 1.5	Control new invasive plant infestations promptly, suppress or contain expansion of infestations where control is not practical, conduct follow up inspection of treated sites to prevent reestablishment.
Goal 2 - Minimize the creation of conditions that favor invasive plant introduction, establishment and spread during land management actions and land use activities. Continually review and adjust land management practices to help reduce the creation of conditions that favor invasive plant communities.	
Objective 2.1	Reduce soil disturbance while achieving project objectives through timber harvest, fuel treatments, and other activities that potentially produce large amounts of bare ground.
Objective 2.2	Retain native vegetation consistent with site capability and integrated resource management objectives to suppress invasive plants and prevent their establishment and growth.
Objective 2.3	Reduce the introduction, establishment and spread of invasive plants during fire suppression and fire rehabilitation activities by minimizing the conditions that promote invasive plant germination and establishment.
Objective 2.4	Incorporate invasive plant prevention as an important consideration in all recreational land use and access decisions. Use Forest-level Access and Travel Management planning to manage both on-highway and off-highway travel and travel routes to reduce the introduction, establishment and spread of invasive plants.
Objective 2.5	Place greater emphasis on managing previously “unmanaged recreation” (OHVs, dispersed recreation, etc.) to help reduce creation of soil conditions that favor invasive plants, and reduce transport of invasive plant seeds and propagules.
Goal 3 - Protect the health of people who work, visit, or live in or near National Forests, while effectively treating invasive plants. Identify, avoid, or mitigate potential human health effects from invasive plants and treatments.	
Objective 3.1	Avoid or minimize public exposure to herbicides, fertilizer, and smoke.
Objective 3.2	Reduce reliance on herbicide use over time in Region Six.
Goal 4 – Implement invasive plant treatment strategies that protect sensitive ecosystem components, and maintain biological diversity and function within ecosystems. Reduce loss or degradation of native habitat from invasive plants while minimizing adverse effects from treatment projects.	
Objective 4.1	Maintain water quality while implementing invasive plant treatments.
Objective 4.2	Protect non-target plants and animals from negative effects of both invasive plants and applied herbicides. Where herbicide treatment of invasive plants is necessary within the riparian zone, select treatment methods and chemicals so that herbicide application is consistent with riparian management direction, contained in Pacfish, Infish, and the Aquatic Conservation Strategies of the Northwest Forest Plan.
Objective 4.3	Protect threatened, endangered, and sensitive species habitat threatened by invasive plants. Design treatment projects to protect threatened, endangered, and sensitive species and maintain species viability.
Goal 5 – Expand collaborative efforts between the Forest Service, our partners, and the public to share learning experiences regarding the prevention and control of invasive plants, and the protection and restoration of native plant communities.	

Invasive Plants Treatment Goals and Objectives from the R6 2005 ROD	
Objective 5.1	Use an adaptive management approach to invasive plant management that emphasizes monitoring, learning, and adjusting management techniques. Evaluate treatment effectiveness and adjust future treatment actions based on the results of these evaluations.
Objective 5.2	Collaborate with tribal, other federal, state, local and private land managers to increase availability and use of appropriate native plants for all land ownerships.
Objective 5.3	Work effectively with neighbors in all aspects of invasive plant management: share information and resources, support cooperative weed management, and work together to reduce the inappropriate use of invasive plants (landscaping, erosion control, etc.).

In addition, Standards 11 through 23 from the R6 2005 ROD apply to invasive plant treatment and restoration (see table 2). Standards 1 through 10 apply to invasive plant prevention. These standards and additional information about prevention on the Olympic National Forest are displayed in Appendix G. All alternatives assume prevention practices will be implemented as directed.

The R6 2005 ROD standards require that prevention practices be considered in land management activities and decisions. Ongoing programs such as roads, trail, vegetation, habitat and/or timber management can influence invasive plant spread. Prevention of invasive plants is managed in the context of each program's or project's objectives and opportunities. This project EIS focuses on issues and alternatives related to treatment and is tiered to the R6 2005 FEIS programmatic analysis of prevention.

Table 3 shows additional standards from the 1990 Olympic National Forest Plan (as amended by the 1994 Northwest Forest Plan[3]) that apply to municipal watersheds, and Riparian Reserves (a land allocation, including Olympic National Forest System lands, within an area reaching upslope approximately 1 to 2 times the average height of a tree on either side of a creek or water body).

Part of compliance with the Northwest Forest Plan relates to considering watershed analysis recommendations in project planning. Nineteen watershed assessments have been prepared on the Olympic National Forest since 1994. Of these, 13 discuss invasive plants/noxious weeds. Invasive species were also identified as a threat to native plant ecosystems in six Late-Successional Reserve (LSR) Assessments. The watershed assessments and LSR Assessments provide evidence of the presence of invasive plants, their adverse impact, and the need for treatment. [4]

Treatments may also be proposed within wilderness areas. Any treatment within wilderness would be aimed at preserving or protecting wilderness character. Mechanized equipment would not be used.

[3] The Northwest Forest Plan is formally referred to as the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (USDA/USDI 1994).
[4] Watershed assessment and LSR Assessment references and excerpts pertaining to invasive plant management are available in the project files.

Table 2-Standards from the R6 2005 ROD and How the Project Complies with these Standards

Standard #	Forest Plan Standard	How Project Complies with Standard
11	Prioritize infestations of invasive plants for treatment at the landscape, watershed or larger multiple forest/multiple owner scale.	Treatment priorities are described in Chapter 2 and depicted on the treatment area maps in Appendix A.
12	Develop a long-term site strategy for restoring/revegetating invasive plant sites prior to treatment.	Treatment strategies and restoration plans are described in Chapter 2. Appendix B includes common control measures for invasive target species and Appendix F outlines the restoration approach.
13	Native plant materials are the first choice in revegetation for restoration and rehabilitation where timely natural regeneration of the native plant community is not likely to occur. Non-native, non-invasive plant species may be used in any of the following situations: 1) when needed in emergency conditions to protect basic resource values (e.g., soil stability, water quality and to help prevent the establishment of invasive species), 2) as an interim, non-persistent measure designed to aid in the re-establishment of native plants, 3) if native plant materials are not available, or 4) in permanently altered plant communities. Under no circumstances will non-native invasive plant species be used for revegetation.	Revegetation (seeding and planting) would occur as needed to replace invasive plants with native plant communities. Non-native, non-persistent species may be used infrequently as an interim measure to control erosion or prevent target species from returning on treated sites. Appendix F outlines the restoration approach including use of native plant materials.
14	Use only USDA Animal and Plant Health Inspection Service (APHIS) and State-approved biological control agents. Agents demonstrated to have direct negative impacts on non-target organisms would not be released.	APHIS and Washington state approved Biological Agents currently released within or near Olympic National Forest are listed in Chapter 2. Agents found to have negative impacts may not be distributed on the Olympic National Forest; this list will be updated annually and discussed with adjacent landowners.
15	Application of any herbicides to treat invasive plants will be performed or directly supervised by a State or Federally licensed applicator. All treatment projects that involve the use of herbicides will develop and implement herbicide transportation and handling safety plans.	The elements of herbicide transportation and handling safety plans are listed in Chapter 2. Policies/compliance monitoring and reporting forms related to herbicide use are further discussed in Appendix E.
16	Select from herbicide formulations containing one or more of the following 10 active ingredients: chlorsulfuron, clopyralid, glyphosate, imazapic, imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, and triclopyr. Mixtures of herbicide formulations containing 3 or less of these active ingredients may be applied where the sum of all individual Hazard Quotients for the relevant application scenarios is less than 1.0. * All herbicide application methods are allowed including wicking, wiping, injection, spot, broadcast and aerial, as permitted by the product label. Chlorsulfuron, metsulfuron methyl, and sulfometuron methyl will not be applied aerially. The use of triclopyr is limited to selective application techniques only (e.g., spot spraying, wiping, basal bark, cut stump, injection). Additional herbicides and herbicide mixtures may be added in the future at either the Forest Plan or project level through appropriate risk analysis and NEPA/ESA procedures.	See Chapter 2 for details about Project Design Features (PDFs), which add layers of caution and minimize or eliminate adverse effects related to use of herbicides and adjuvants. The herbicide formulations listed in this document are approved for use according to the PDFs. Table 28 lists the herbicide formulations that currently meet Standards 16 and 18, based on analysis by Bakke (2003a and 2003b) and SERA (various, see Chapter 3.1.5) and disclosures herein. Since the release of the DEIS, the herbicide formulation Habitat (the aquatic formulation for Imazapyr) has become approved for use. Policies/compliance monitoring and reporting forms related to herbicide use are further discussed in Appendix E.
17	The 2005 ROD does not include any Standard 17	

Standard #	Forest Plan Standard	How Project Complies with Standard
18	Use only adjuvants (e.g. surfactants, dyes) and inert ingredients reviewed in Forest Service hazard and risk assessment documents.	R6 has provided a list of adjuvants that meet this standard. In addition, the project follows State of Washington regulations for adjuvant use near surface waters.
19	To minimize or eliminate direct or indirect negative effects to non-target plants, terrestrial animals, water quality and aquatic biota (including amphibians) from the application of herbicide, use site-specific soil characteristics, proximity to surface water and local water table depth to determine herbicide formulation, size of buffers needed, if any, and application method and timing. Consider herbicides registered for aquatic use where herbicide is likely to be delivered to surface waters.	Chapter 3 discusses how risks from herbicide use are abated by Project Design Features including buffers and restrictions on herbicide use and method of application in Aquatic Influence Zones and roadside treatment areas that have high potential to deliver herbicide to streams and other water bodies. .
20	Design invasive plant treatments to minimize or eliminate adverse effects to species and critical habitats proposed and/or listed under the Endangered Species Act. This may involve surveying for listed or proposed plants prior to implementing actions within unsurveyed habitat if the action has a reasonable potential to adversely affect the plant species. Use site-specific project design (e.g. application rate and method, timing, wind speed and direction, nozzle type and size, buffers, etc.) to mitigate the potential for adverse disturbance and/or contaminant exposure.	Chapter 3 discusses how potential adverse effects to Endangered Species and critical habitats from herbicide use are abated by Project Design Features.
21	Provide a minimum buffer of 300 feet for aerial application of herbicides near developed campgrounds, recreation residences and private land (unless otherwise authorized by adjacent private landowners).	No aerial application is proposed.
22	Prohibit aerial application of herbicides within legally designated municipal watersheds.	No aerial application is proposed. Coordination with water users would occur in accordance with Municipal Watershed Plans (more information in Chapter 3).
23	Prior to implementation of herbicide treatment projects, National Forest staff will ensure timely public notification. Treatment areas will be posted to inform the public and forest workers of herbicide application dates and herbicides used. If requested, individuals may be notified in advance of spray dates.	Chapter 2 lists Project Design Features, including public notification requirements. Policies/compliance monitoring and reporting forms related to herbicide use are further discussed in Appendix E.

*ATSDR, 2004. Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures. U.S. Department Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry.

Table 3-Additional Olympic National Forest Plan Standards and How the Project Complies with These Standards

Forest Plan Standard	How Project Complies with Standard
Apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives.	Invasive species are degrading native plant communities and habitats. Invasive plants retard or prevent recovery of native plant communities, which may reduce structural diversity of plant communities in riparian areas. Vegetation management is necessary within Riparian Reserves to restore native plant communities that have been affected by invasive plants. The adverse impacts of invasive plants are discussed under "Affected Environment" in each resource section of Chapter 3.
Herbicides, insecticides, and other toxicants, and other chemicals shall be applied [within Riparian Reserves] only in a manner that avoids impacts that retard or prevent attainment of Aquatic Conservation Strategy objectives.	Compliance with Aquatic Conservation Strategy objectives is discussed in Chapter 3.4. As currently designed, Alternative D would not be consistent with the Aquatic Conservation Strategy because of its higher potential to deliver herbicide to streams and other water bodies. If Alternative D were to be selected, additional mitigation would be required to ensure that herbicide use near dry streams and along higher risk roads was done in a manner consistent with the Aquatic Conservation Strategy, or a project-specific Forest Plan amendment would be required.
Herbicides and pesticides should not be used in municipal watersheds. Chemicals should be used as a last resort, and only where analysis demonstrates water quality will not be adversely affected.	Herbicide use is proposed in municipal watersheds as a part of this project to meet the purpose and need for action. Drinking water would be protected (see buffers and design features in Chapter 2.5, especially PDF B3 and H12). Treatments would be done in accordance with individual municipal watershed agreements. Chapter 3.4 summarizes the potential effects of invasive plant treatments proposed within municipal watersheds.

1.5 Decision Framework

The Forest Supervisor for the Olympic National Forest is the Responsible Official for this EIS. The Forest Supervisor will review the environmental consequences to decide whether to implement the Proposed Action (Alternative B), another action alternative, or continue to implement the No Action alternative (Alternative A).

Factors influencing the decision include:

1. Effectiveness in reaching control objectives for invasive plants, as indicated by the acreage of invasive plants estimated for the year 2012 (under the most ambitious conceivable treatment scenario as defined in Chapter 3.1).
2. Potential adverse effects to human health and the environment, as indicated by the effects analysis throughout Chapter 3, and
3. Monetary costs and financial efficiency, as indicated by the economic efficiency analysis displayed in Chapter 3.7.

1.6 Public Involvement

This FEIS has been developed over many years. It was first listed in the Olympic National Forest Schedule of Proposed Actions in January 2004 and a Notice of Intent (NOI) to prepare an EIS requesting public input was published in the Federal Register on February 23, 2004. The NOI proposed a project with a geographic scope covering the Olympic National Forest, along with two other National Forests in western Washington and Oregon and the Columbia River Gorge National Scenic Area. Individuals, organizations, agencies, businesses, and local and Tribal governments were contacted by letter and solicited for comments on the proposal.

Approximately 150 comments were received. One concern was the large geographical scope of the project. Another concern was that the programmatic R6 FEIS was not complete so management direction pertinent to the project was in flux.

The Forest Service decided to prepare an EIS specific to the Olympic National Forest, and to reinitiate scoping in August 2005, following the public release of the R6 2005 FEIS. A new NOI was published on August 25, 2005, and a letter describing an updated proposal was widely circulated. The public was advised that the 2004 comments would still be considered, along with any new comments. Approximately 15 comments were received during the second scoping period.

The following section (1.6.1) summarizes the significant issues identified through the scoping process and discusses how they are addressed in the EIS analysis. The issues are grouped into broad resource categories. Issue Group 1 relates to human health, Issue Group 2 relates to the effectiveness of treatments, Issue Group 3 relates to social and economic issues, Issue Group 4 relates to effects on non-target terrestrial plant and animal species, and Issue Group 5 relates to soils, water quality and aquatic organisms. Table 4 displays how each significant issue is addressed and the factors for alternative comparison.

The project file includes scoping comments received during both scoping periods, copies of the 2004 and 2005 NOIs, scoping outreach letters and legal notices.

The topics listed here do not reflect issues that were raised with this proposal, but are required disclosures for EIS documents. These are addressed in Chapter 3.

- Congressionally Designated Areas
- Prime Farm and Forest Lands
- Cultural Resources
- Relationship Between Short-term Uses and Long-term Productivity
- Conflicts with Other Policies, Plans, Jurisdictions
- Irretrievable and Irreversible Commitment of Resources

1.6.1 Issue Group 1: Human Health and Worker Safety

Issue Components:

1a: Exposure to Herbicides

1b: Drinking Water

1c: Worker Safety

1a: Exposure to Herbicides

Issue Statement: People, including neighbors, visitors, and herbicide applicators, may become exposed to herbicides from invasive plant treatments and experience adverse health effects.

This issue has been resolved by the Standards in the R6 2005 ROD. Chapter 4.5 and Appendix Q of the R6 2005 FEIS provided detailed descriptions of the hazards associated with the herbicides proposed for use. The herbicides available for use (Standard 16) were selected because they pose comparatively low risks to people. Standard 15 requires that all projects be implemented by certified applicators who have been training in herbicide safety. Standard 23 requires public notification prior to using herbicides.

The Project Design Features in all alternatives further reduce risk by practices such as limiting herbicide application rates, favoring formulations with the lowest possible risks, and temporarily closing areas such as campgrounds or special forest product gathering areas to ensure no inadvertent contact between people and herbicides occurs. All alternatives would be implemented to follow pesticide use policies of the US Forest Service (see FSH 2109.14, Appendix E) intended to reduce risk to human health.

1b: Drinking Water

Issue Statement: Herbicides may contaminate drinking water through direct contact (a spill into a drinking water source), or indirectly through leaching, percolation, or run off.

This issue has been resolved by compliance with the Standards in the R6 2005 ROD and other management direction (Clean Water Act, Olympic National Forest Plan). The herbicide risk assessments and analysis in the R6 2005 FEIS, especially Appendix Q, demonstrate that there is very low risk of drinking water contamination or health impacts from the herbicides and types of applications proposed for use. Project Design Features for all alternatives ensure that herbicide mixing would occur away from streams and water sources.

No herbicides would be applied near wells and or springs (PDF H12). Safe transportation and handling of herbicides, and spill containment, would be documented in a pre-project plan (PDF G). Chapter 3.4 discusses why herbicide would not be delivered to drinking water in concentrations of concern. Chapter 3.6 discusses the human health effects analysis.

1c: Worker Injuries

Issue Statement: Workers may be injured (sprains, strains, cuts and falls) during invasive plant treatments.

This issue is addressed by adherence to OSHA guidelines in all alternatives. Some people perceive that risks to workers are greatest from herbicide treatments due to potential chemical exposure (see Issue 1a). Others perceive that non-herbicide treatments are more likely to result in physical injuries since these methods tend to be more labor-intensive. Injuries associated with non-herbicide work are not considered unusual and are mitigated through accepted field safety practices. Therefore, this issue will not be tracked through the analysis.

1.6.2 Issue Group 2 – Treatment Strategy and Effectiveness

Issue Components:

2a: Effectiveness of Treatment Methods

2b: Long-term Strategy

2c: Treatment Priority

2d: Adaptive Management/Early Detection-Rapid Response

2a – Effectiveness of Treatment Methods

Issue Statement: Restrictions on herbicide use tend to reduce treatment effectiveness and increase cost. Many invasive plants do not respond effectively to manual and mechanical treatments without herbicide.

The Proposed Action and Alternative D allow for the use of herbicides in most invasive plant situations. With unlimited funding, existing infestations would largely be controlled by 2012. [5]

[5] The most ambitious treatment scenarios for each alternative are described in Chapter 3.1 and used as the basis for comparison of effects. This scenario is unlikely to occur because it would require at least a five-fold increase in

Alternative C, however, would rely on manual and mechanical methods on a greater proportion of the infested acreage, which decreases the likelihood that control objectives may be met, especially for sites having a control objective of eradicate. If control objectives are not met, adverse effects of invasives would continue.

This is a key issue tracked throughout this document. The alternatives are compared by:

- The number of herbicide formulations available for use
- The proportion of infested acres that may be treated using herbicide
- Acres of invasives predicted for the year 2012

2b – Long-term Strategy, Reduce Reliance on Herbicides Over Time

Issue Statement: Treated sites need to be restored to hasten recovery of native vegetation and reduce reliance on herbicides over time.

Treatment prescriptions in all alternatives include site restoration (passive revegetation, mulching, seeding, and planting). Manual and mechanical follow-up treatments would be favored, especially when populations are small enough to control without herbicides.

Restoration is described in Chapter 2 and Appendix F. Restoration prescriptions do not vary significantly between action alternatives. Multi-year treatment scenarios demonstrating declining reliance on herbicides are displayed in Chapter 3.1.

2c – Treatment Priority

Issue Statement: Treatments must be prioritized so that available funding can be utilized as efficiently as possible.

This issue is addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan as amended by the R6 2005 ROD. The standards require that invasive plant treatments sites be prioritized. Treatment priorities are described in Chapter 2.5. Treatment priorities do not vary between alternatives; however, given limited budgets, alternatives that cost more per acre to implement are less likely to treat all high priority sites.

2d – Adaptive Management/Early Detection-Rapid Response

Issue Statement: The Forest Service needs the ability to respond rapidly to new infestations and improve effectiveness through adaptive management.

This issue is addressed through inclusion of an adaptive management plan and early detection-rapid response strategy in all action alternatives. The adaptive management plan and early detection-rapid response strategy is described in Chapter 2 and does not vary significantly between alternatives.

1.6.3 Issue Group 3 – Social and Economic

Issue Components:

3a: Treatment Costs and Financial Efficiency

3b: More Jobs Associated with Manual Treatments

3c: Effects on Scenic, Recreation, and Wilderness Values

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expected funding, however it provides a basis for analysis and highlights differences in effectiveness between the alternatives.

3d: Effects on Special Forest Products

3e: Effects on American Indian Tribes and Treaty Rights, Civil Rights and Environmental Justice

3a – Treatment Costs and Financial Efficiency

Issue Statement: Treatment costs vary depending on method. Non-herbicide methods tend to be more expensive than herbicide methods. Spot and hand herbicide application methods tend to be more expensive that broadcast herbicide methods.

This issue is addressed through the development of Alternative D, which emphasizes use of broadcast herbicide methods. In contrast, the Proposed Action restricts broadcast herbicide application methods in many situations and Alternative C does not allow any broadcast treatment. Alternative C also relies on non-herbicide methods on about 70 percent of currently infested acreage, which increases treatment costs.

This is a key issue tracked throughout this document. The alternatives are compared by:

- Total cost for the most ambitious conceivable project over a 5 year period
- Average annual cost for the most ambitious conceivable project over a 5 year period
- Average cost per acre of treatment over a 5 year period

3b – More Jobs Associated with Manual Treatments

Issue Statement: Manual treatments tend to be more labor-intensive and employ more workers than herbicide treatment methods.

This issue is addressed through the development of Alternative C, which has the greatest relative proportion of manual treatments compared to the other action alternatives.

This is a key issue tracked throughout this document. The alternatives are compared by:

- The estimated number of jobs provided by the most ambitious treatment scenario

3c – Effects of Invasive Plant Treatment on Scenic, Recreation and Wilderness Values

Issue Statement: Invasive plant treatments may be visible along road corridors and in recreation and wilderness areas.

This issue is addressed through adherence to invasive plant treatment management direction in the Olympic National Forest Plan as amended by the R6 2005 ROD. Over the long term, controlling invasive plants would improve scenic, recreation and wilderness values. Potential effects on these values are described in Chapter 3.

3d – Effects of Herbicide on Special Forest Products and Gatherers

Issue Statement: Herbicide treatments may leave residues on special forest products making them unsafe for consumption or unsuitable for collection.

This issue is addressed through adherence to invasive plant treatment management direction in the Olympic National Forest Plan as amended by the R6 2005 ROD. These standards require public education and a public notification strategy if herbicides are used.

The Project Design Features described in Chapter 2 ensure that conflicts between treatments and special forest products and gathering areas are minimized. Potential effects on special forest products and gatherers are described in Chapter 3.

3e – Effects on American Indian Tribes and Treaty Rights, Civil Rights and Environmental Justice

Issue Statement: Invasive plant treatments may harm culturally important plants or have disproportionate effects on cultures that rely on subsistence or special forest product gathering. Asian, Hispanic, and Native American communities may be impacted by invasive plant treatments.

Executive Order 12898 (1994) requires federal agencies to identify and address adverse effects to human health and the environment that may disproportionately impact minority and low-income people. Also, the Executive Order directs agencies to consider patterns of subsistence hunting and fishing when an agency action may affect fish and wildlife.

This issue is addressed in all alternatives through Project Design Features described in Chapter 2. These include ongoing consultation with American Indian Tribes, outreach with subsistence and special forest product gathering communities, and public notification of herbicide treatments through the newspaper, onsite posting, and use of flyers.

1.6.4 Issue Group 4 – Effects on Non-Target Plants and Wildlife

Issue Components:

4a: Effects on Non-Target Botanical Species of Local Interest

4b: Effects of Herbicides on Terrestrial Wildlife Species of Local Interest

4a – Effects of Herbicide on Non-Target Botanical Species of Local Interest

Issue Statement: Herbicides may harm native plants due to drift (especially from broadcast treatments), runoff, and/or leaching. The potential for adverse effects to non-target species are dependent on the type of herbicide used and the application method chosen. Non-target vascular plants, lichens, bryophytes, and fungi in close proximity to invasive plants, especially species of local interest, are at particular risk because they are rarer or more susceptible to pollutants, including biological pollutants such as invasive plants.

This issue is addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan as amended by the R6 2005 ROD. The R6 2005 FEIS provided detailed assessments of the risks to non-target vegetation from herbicide. Chapter 2 describes the Project Design Features intended to avoid potential harm and Chapter 3.2 discusses the potential for adverse effects to non-target botanical species.

Effects on non-vascular plants are especially uncertain when broadcast herbicide application methods are used. This uncertainty cannot be fully mitigated. Thus, the alternatives are compared by:

- Estimated Proportion of Project With Potential Broadcast Application

4b – Effects of Herbicide on Terrestrial Wildlife Species of Local Interest

Issue Statement: Invasive plant treatments may disturb wildlife or trample wildlife habitat. Wildlife may contact herbicides or ingest invasive plants treated with herbicide and become sick or die.

This issue is generally addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan as amended by the R6 2005 ROD. Chapter 2 describes the Project Design Features intended to avoid potential harm to wildlife and Chapter 3 explains why the potential for adverse effects to wildlife is minimized in all alternatives.

However, herbicide effects on specific wildlife species of local concern may be uncertain because studies are limited. This issue is of specific interest to FWS in regards to species listed or proposed for listing under the federal Endangered Species Act (ESA).

Consultation with FWS was documented through the Forest Service Biological Assessment (BA). In a letter dated May 18, 2007, the FWS concurred with the FS effect determinations for bald eagle, marbled murrelet, and northern spotted owl (FWS BO 2007)[6] Bald eagle has since been taken off the Endangered Species list. It is still considered a Regional Forester's Sensitive Wildlife Species on the Olympic National Forest.

1.6.5 Issue Group 5 – Effects on Soils, Water and Aquatic Organisms

Issue Components:

5a: Potential Adverse Effects of Invasive Plant Treatment on Soils

5b: Potential for Herbicide Delivery to Streams, Lakes, Rivers, Floodplains and Wetlands

5c: Potential for Herbicides to Result in Adverse Effects to Aquatic Ecosystems

5a – Potential Adverse Effects of Invasive Plant Treatment on Soils

Issue Statement: Invasive plants provide ground cover that may be disturbed by treatments. Herbicide use may harm soil organisms or soil biology. This issue is addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan as amended by the R6 2005 ROD. Chapter 2 describes the Project Design Features intended to avoid potential harm and Chapter 3 explains why the potential for adverse effects to soils are minimized in all alternatives.

5b – Potential for Herbicide Delivery to Streams, Lakes, Rivers, Floodplains and Wetlands

Issue Statement: Herbicides used near or along streams, lakes, rivers, floodplains and wetlands may enter surface or ground waters through drift, runoff, leaching or direct contact. Roads with high potential to deliver herbicides can function as conduits for herbicide delivery to these water bodies.

This issue is primarily addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan as amended by the R6 2005 ROD. Chapter 2 describes the Project Design Features intended to minimize the chance that herbicide concentrations of concern would enter streams. Broadcast treatments have the greatest potential for off site movement of herbicides; spot and hand treatments result in far less risk of herbicide delivery to water bodies. Thus, Project Design Features and buffers are proposed to limit broadcast within the Aquatic Influence Zone (an area defined as half the distance of a Riparian Reserve). Fish bearing streams have an Aquatic Influence Zone of approximately 150 feet (50 meters) each side of a stream – half the 300 foot Riparian Reserve for such a stream).

The alternatives are compared by:

- Character of herbicide use within Aquatic Influence Zones
- Estimated acres of herbicide use within Aquatic Influence Zones
- Estimated acreage of herbicide treatment on roadside treatment areas with high potential to deliver herbicides

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[6] The Forest Service submitted a single Biological Assessment covering aquatic and terrestrial federally listed species in January 2007. FWS and NMFS responded with letters of concurrence on the portions of the project with a determination of "May Affect, Not Likely to Adversely Affect" (FWS, April 2007 and NMFS, May 2007) and Biological Opinions on the portions of the project with the determination of "May Affect, Likely to Adversely Affect" (FWS, Sept. 2007) and NMFS, October 2007) covering various portions of project.

- Estimated proportion of project where broadcast treatment may occur on roadside treatment areas with high potential to deliver herbicides

5c – Potential for Adverse Effects to Aquatic Organisms from Herbicide

Issue Statement: Herbicides that enter water bodies may harm aquatic organisms, including fish species of local interest.

This issue is addressed by limiting the herbicide formulation and application rate, timing, and method so that the risk of adverse effects is minimized or eliminated. The alternatives vary as to the treatments allowed in Aquatic Influence Zones and along roadsides with high potential to deliver herbicides to streams. These differences influence the level of risk that herbicides will enter water bodies. The alternatives are compared by:

- Potential for aquatic organisms to be exposed to harmful concentrations of herbicide

The invasive plant treatment BA was developed by an interagency consultation team (referred to as the Level 1 Team) including staff from the FS, NMFS), and the FWS. The Level 1 Team worked together periodically over the past two years to review and develop project design criteria that incorporate the best management practices to minimize adverse effects to aquatic resources. The BA describes and evaluates the effects of manual, mechanical and chemical invasive plant treatment methods (FWS 2007 BO, page 1.)

1.6.6 Summary of Significant Public Issues and Alternative Comparison Factors

Table 4 summarizes how the issues are addressed and factors used to compare the effects of the alternatives.

Table 4-Significant Issues, How Issues are Addressed, and Factors for Alternative Comparison

Issue Group	Issue Component	How Issue is Addressed	Factors for Alternative Comparison
1 – Human Health and Worker Safety	1a – Exposure to Herbicides	Exposure scenarios that may harm workers and/or the public are avoided in all alternatives.	No substantial difference between action alternatives
1 – Human Health and Worker Safety	1b – Drinking Water	No plausible scenarios for public harm due to drinking water contamination are associated with any alternative.	No substantial difference between action alternatives
1 – Human Health and Worker Safety	1c – Worker Safety	Adherence to OSHA guidelines.	No substantial difference between action alternatives; not tracked further in this document.
2 – Treatment Strategy and Effectiveness	2a – Range of Treatment Methods Approved	Analysis of differences in treatment effectiveness based on restrictions to herbicide use.	· The number of herbicides available for use · Percent of infested land base where herbicide may be used
2 – Treatment Strategy and Effectiveness	2b – Long-term Strategy, Reduce Reliance on Herbicides Over Time	Treatment prescriptions in all alternatives include site restoration (passive revegetation, mulching, seeding, and planting). Manual and mechanical follow up treatments would be favored, especially when populations are small enough to control without herbicides.	No substantial difference between action alternatives. Restoration strategy is in Appendix F and Chapter 2.5; declining reliance on herbicide over time is addressed in Chapter 3.1.
2 – Treatment Strategy and Effectiveness	2c – Treatment Priority	Invasive plant treatment areas are prioritized.	No substantial difference between action alternatives; see Chapter 2.5 for how priorities were set.

Issue Group	Issue Component	How Issue is Addressed	Factors for Alternative Comparison
2 – Treatment Strategy and Effectiveness	2d – Adaptive Management/Early Detection-Rapid Response	An adaptive management plan and early detection-rapid response strategy is part of all action alternatives.	No substantial difference between action alternatives, see discussions in Chapter 2.5.
Issue Group 3 – Social and Economic	3a – Treatment Costs and Financial Efficiency	Analysis of the total and annual estimated costs of treatment and financial efficiency.	·Total estimated project cost over a 5-year period. ·Annual estimated project cost over a 5-year period ·Average cost of a treatment acre over a 5-year period
Issue Group 3 – Social and Economic	3b – More Jobs Associated with Manual Treatments	Analysis of the estimated number of worker days needed for the project.	· The estimated number of jobs provided by the most ambitious treatment scenario
Issue Group 3 – Social and Economic	3c – Scenic, Recreation, and Wilderness Values	This issue is addressed in all alternatives through the Project Design Features described in Chapter 2, including coordination and notification requirements.	No substantial difference between action alternatives, see Project Design Features in Chapter 2.5.
Issue Group 3 – Social and Economic	3d– Effects on Special Forest Products	This issue is addressed in all alternatives through public education, notification and outreach to special forest product gatherers. Project Design Features described in Chapter 2 include coordination and notification requirements.	No substantial difference between action alternatives; no exposure scenarios are associated with people harvesting or eating special forest products near sprayed areas.
Issue Group 3 – Social and Economic	3e – Effects on American Indian Tribes and Treaty Rights, Civil Rights and Environmental Justice	This issue is addressed through consultation with tribes, outreach to subsistence gatherers, and extensive public notification.	No substantial difference between action alternatives, no disproportionate effects on any minority group; see Chapter 3.6.
Issue Group 4 –Non-Target Plants And Wildlife	4a – Adverse Effects of Herbicide Treatment on Botanical Species Of Local Interest	This issue is addressed through development of Project Design Features intended to avoid potential adverse effects to non-target plants.	·Acres of Broadcast Allowed ·Number of Plant Species of Local Interest Potentially Affected by Broadcast Herbicide Application Methods
Issue Group 4 – Non-Target Plants And Wildlife	4b – Potential Adverse Effects Of Invasive Plant Treatment On Terrestrial Wildlife, Species Of Local Interest	This issue is addressed through development of Project Design Features intended to minimize potential adverse effects to terrestrial wildlife, including salamanders and mollusks.	No substantial difference between action alternatives; none of the alternatives are likely to adversely affect or impact any wildlife species of local interest.
Issue Group 5 – Effects on Soils, Water and Aquatic Organisms	5a – Potential Adverse Effects of Invasive Plant Treatment on Soils	This issue is addressed through Project Design Features intended to avoid potential harm to soils.	No substantial difference between action alternatives; none of the alternatives would harm soil productivity.

Issue Group	Issue Component	How Issue is Addressed	Factors for Alternative Comparison
Issue Group 5 – Effects on Soils, Water and Aquatic Organisms	5b – Potential for Herbicide Delivery to Streams, Lakes, Rivers, Floodplains and Wetlands	This issue is addressed through Project Design Features intended to minimize herbicide delivery to water.	· Character of herbicide use within Aquatic Influence Zones ·Estimated acres of herbicide use within Aquatic Influence Zones · Estimated acreage where herbicide treatment may occur on roadside treatment areas with high potential to deliver herbicides · Estimated proportion of project where broadcast of herbicide may occur on roadside treatment areas with high potential to deliver herbicides
Issue Group 5 – Effects on Soils, Water and Aquatic Organisms	5c – Potential for Adverse Effects on Aquatic Organisms from Herbicide	This issue is addressed through Project Design Features intended to avoid herbicide delivery to water and minimize or eliminate risk of concentrations above a threshold of concern to fish and aquatic ecosystems. Treatment situations likely to result in herbicide concentrations of concern to fish are avoided in all alternatives except D: analysis for Alternative D indicates that herbicide concentrations of concern to aquatic organisms are possible under worst-case conditions.	• Potential for aquatic organisms to be exposed to harmful concentrations of herbicide

1.6.7 Comments to the DEIS

The public was invited to comment on the Draft Environmental Impact Statement between June 16 and July 31, 2006. Appendix H displays the content of the public and agency comments and specific Forest Service responses, along with copies of all letters received from government agencies.

Nearly all of the comments focused on effects to water quality and fish from the use of herbicides within riparian reserves and near fish habitat. Two of the commenters asserted a preference for Alternative C, which does not allow herbicide use in riparian reserves or along roads with high potential to deliver herbicides to water bodies.

The Proposed Action was modified (see Chapter 2.5), and additional information has been provided throughout the EIS in response to these comments. The FS has worked closely with NMFS to address their comments through the Endangered Species Act Consultation process.

1.7 Non-Significant Issues

The Council of Environmental Quality requires the USDA Forest Service to identify and eliminate from detailed study the issues that are not significant (40 CFR 1501.7). Issues are eliminated from further analysis when the issue is outside the scope of the EIS; is already decided by law, regulation, Forest Plan, or other higher level decision; is not clearly relevant to the decision to be made; or is conjectural and not supported by credible scientific or factual evidence.

The Forest Supervisor for the Olympic National Forest determined that the following public issues would be eliminated from further analysis:

1.7.1 Funding and Partnerships for Managing Invasive Plants on Private Land

Some people expressed that invasive plant treatments on private lands should be funded or technical assistance provided for private landowners, and that management of noxious weeds can also be improved on both public and private lands by the formation and participation in weed management areas. This issue is outside the scope of this analysis and is therefore not significant to the project analysis.

The Forest Service supports establishing weed management areas in partnership with others. All alternatives would be consistent with such partnerships and the likelihood of success would certainly be increased. However, establishment of weed management areas may be accomplished without consideration in an EIS.

Technical assistance for projects off National Forest is available and is not subject to consideration in an EIS. National Environmental Policy Act (NEPA) documentation may be required when federal funding is used for work on other ownerships. No specific proposals for work off-National Forest System lands were brought forward during initial project development and scoping, thus, none could be evaluated as a connected action. However, similar work on adjacent lands has occurred in the past and will likely continue to occur.

1.7.2 Funding Sources and Commitments

Several commenters mentioned that project effectiveness is directly related to funding. Funding secured for the past several years is not adequate to fully implement any action alternative. While this is an important issue relevant to the ability of the Forest Service to meet the purpose and need, it is outside the scope of this EIS because it cannot be resolved through the NEPA process.

Funding is dependent on many unpredictable factors and some sources may become available once a NEPA decision has been made. Financial efficiency analysis displays estimated costs of treating all known infestations over a five-year period. The average cost of a treatment acre is also disclosed. This information can be used to demonstrate funding that would be needed over time to complete the project, however this NEPA document cannot guarantee that all planned work would be funded.

1.7.3 Linking the Project to Other Initiatives

Some comments suggested linking this invasive plant project EIS to the Fuels Reduction and Healthy Forest Initiatives or other initiatives to provide a more strategic approach to controlling invasive plants rather than a stand alone document.

One role of the Olympic National Forest Supervisor is to consider the scope of Proposed Actions in the context of other actions that may be connected. In the case of invasive plant management, several approaches may be valid; for instance, invasive plant treatments could be addressed through project planning at a watershed scale that integrates invasive plant treatments with other vegetation management proposals. In the past, invasive plant treatments have been connected with projects intended to improve forest health or reduce fuels.

In this case, the Forest Supervisor decided to consider invasive plant management Forest-wide to allow for timely treatment wherever the need arises, and however funding may be secured. In some cases, treatments may be linked with other projects, and future NEPA documents will likely tier to analysis herein so that integrated resource management can be achieved in the best way possible. However, no matter what other actions occur in the project area, the current invasive plant inventory demonstrates the ongoing need for treatment.

Thus, actions other than invasive plant management are not connected to this proposal, so linking this EIS to forest health or fuels reduction projects is outside the scope of this EIS and not a significant issue for the analysis.

Chapter 2. Alternatives, Including the Proposed Action

2.1 Introduction

Chapter 2 describes and compares alternatives considered for invasive plant treatment on the Olympic National Forest in the state of Washington. Chapter 2 focuses on the resource trade-offs associated with differences between the alternatives.

The descriptions of the alternatives in Chapter 2 are derived from a detailed project database founded on invasive plant inventories and refined using anecdotal information. The project area was divided into treatment areas that were classified by the type of site (e.g., roads, administrative sites, meadows) and prioritized considering the threat posed by existing invasive species and the potential for effective treatment. Treatment methods (herbicide and non-herbicide) and strategies were identified based on the location, extent and biology of the existing invasive plant species. Treatment priorities, methods and strategies are tiered to the R6 2005 FEIS. A primary focus of the site-specific analysis is development of Project Design Features so that invasive plant treatments comply with the recently adopted treatment and restoration standards.

2.2 Alternative Development Process

In 2004, all known invasive plant sites (field surveys were completed on main vectors) were mapped and entered into an inventory data base. Infested sites were aggregated into treatment areas, and control measures, strategies, objectives and priorities were determined. The treatment areas were then classified by the type of site (e.g., roads, administrative sites, meadows) and prioritized considering the threat posed by existing invasive species and the potential for effective treatment. Treatment methods (herbicide and non-herbicide) and strategies were identified based on the location, extent and biology of the existing invasive plant species. The treatment priorities, methods and strategies in the Proposed Action were developed based on the R6 2005 FEIS. In 2004 and 2005, the public was asked to provide scoping input on the Proposed Action. Public issues were identified (see Chapter 1), and Project Design Features (see Chapter 2.5) were developed so that invasive plant treatments using herbicide would comply with the recently adopted treatment and restoration standards and resolve public issues to the extent possible.

Alternative C was developed to further resolve public concerns about herbicide use. Alternative C would eliminate most adverse effects from herbicide by 1) eliminating broadcast applications, which account for most of the concern/uncertainty related to herbicide use and 2) eliminating use of herbicide within Riparian Reserves and along roadsides that cross or follow streams. Eliminating such herbicide use resolves nearly all public issues related to adverse effects of herbicide.

Alternative D was developed to allow more flexibility in broadcasting herbicide on certain road systems. This alternative highlights trade offs between economic effectiveness and risk to water quality and aquatic organisms.

Other alternatives were considered but were eliminated from detailed study. These are discussed in Chapter 2.8.

The DEIS was circulated for public comment May 2006. Throughout the next year and a half, the Forest Service worked with NMFS and FWS to respond to concerns about herbicide use and its effects on fish and fish habitat.

2.3 Invasive Plant Treatment Methods

All of the alternatives (including No Action) employ a variety of invasive plant treatment methods.[7] This section offers a brief description of the different methods proposed for manual/mechanical and herbicide treatments in all alternatives, including No Action. These descriptions are based on Tu, et. al. 2001, edited for local conditions and knowledge.

Manual and Mechanical Methods for Treatment and Restoration

Manual techniques include hand pulling, clipping, or digging out invasive plants with non-motorized hand tools. Mechanical methods involve chain saws, mowers, or other mechanized equipment. 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.

Weed Pulling - Pulling or uprooting plants 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 are surprisingly powerful and 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.

The advantages of pulling include its small ecological impact, minimal damage to neighboring plants, and low (or no) cost for equipment or supplies. Pulling is extremely labor intensive, however, and is effective only for relatively small areas, even when abundant volunteer labor is available. Hand pulling is easy to plan and implement, and is often the best way to control small infestations, such as when a weed is first detected in an area. Hand pulling may be a good alternative in sites where herbicides or other methods cannot be used.

The key to effective hand pulling is to remove as much of the root as possible while minimizing soil disturbance. For many species, any root fragments left behind have the potential to re-sprout, and pulling is not effective on plants with deep and/or easily broken roots.

Most weed-pulling tools are designed to grip the weed stem and provide the leverage necessary to pull its roots out. Tools vary in their size, weight, and the size of the weed they can extract. The Root Talon is inexpensive and lightweight, but may not be as durable or effective as the all-steel Weed Wrench, which is available in a variety of sizes. Both tools can be cumbersome and difficult to carry to remote sites. Both work best on firm ground as opposed to soft, sandy, or muddy substrates.

Clip – “Clip” means to cut or remove seed heads and/or fruiting bodies to prevent germination. This method is labor intensive but effective for small and spotty infestations.

Clip and Pull – “Clip and pull” means 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.

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[7] The alternatives vary as to the total and relative amount of treatment approved and some alternatives do not approve some treatment options listed. Appendix A displays proposed treatment methods based on the current inventory. These are subject to change given local conditions at the time of implementation.

Mowing, Cutting, Brush Hog, Raking, Trimming, Weed-eating - Mowing and cutting can reduce seed production and restrict weed growth, especially in annuals cut before they flower and set seed. Some species however, re-sprout vigorously 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 resprouting, or as follow up treatments to treat target plants missed by initial herbicide use.

Stabbing - Some plants can be killed by severing or injuring (stabbing) the carbohydrate storage structure at the base of the plant. 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 - 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.

Active Restoration - Active post-treatment site restoration includes hand or machine mulching (machines limited to areas that are on roads), along with competitive seeding, and/or planting with hand tools.

Steaming or Foaming - Pouring boiling hot water onto weeds, or subjecting weeds to hot steam, is a method of weed control that has been practiced for some time. A hot foam system for steam-killing vegetation is also available. Hot foam may be an effective treatment for annuals, and with repeated treatments, may be effective for some perennials. No steaming or foaming sites are currently prescribed in any treatment area. Effects are not likely to be substantially different than those disclosed for other treatment methods; however site-specific analysis would be conducted if this equipment is later prescribed.

Herbicide Application Methods

The environmental impacts of three types of herbicide application methods are evaluated in this EIS:

Broadcast (includes but not limited to boom spray) – Broadcast treatments would be used to treat denser (approximately 70 percent or greater) patches of target vegetation. A boom, a long horizontal tube with multiple spray heads, may be mounted or attached to a tractor, all terrain vehicle (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.

Offsite movement due to vaporization or drift and possible treatment of non-target plants can be of concern when using this method. Two alternatives (No Action and Alternative C) do not approve any broadcast treatment.

Not all broadcast methods include a boom; boom-less nozzles are currently in use that can reduce the risk of non-target effects. Backpack pumps and sprayers may also be used as a broadcast tool if directed at a broad area rather than individual plants.

Spot spray - Herbicide is sprayed directly onto small patches or individual target plants; non-target plants are avoided. These 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.

Drift is far less of a concern because the applicator ensures that spray is directed immediately toward the target plant.

Hand/Selective – Hand/selective methods treat individual target plants, reducing the potential for herbicide to impact soil or non-target organisms. Hand/selective methods include wicking and wiping; foliar application; basal bark treatment; frill, hack, and squirt, stem injection, and/or cut-stump methods.

Wicking, Wiping, and other stem and leaf application **-** Involves using a sponge, spray bottle, paint brush, cloth and/or a wick on a long handle to wipe herbicide onto foliage and stems. Use of a wick eliminates the possibility of spray drift.

Basal Bark - This method applies a 6 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 herbicide can be applied with a backpack sprayer, hand-held bottle, or a wick.

Frill, Hack and Squirt - The frill method, also called the "hack and squirt" treatment, is 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.

Stem Injection - Herbicides can be injected into herbaceous stems using a hand held injection system with an attached needle. 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, for instance, the maximum label rate of aquatic labeled glyphosate was used to effectively kill knotweed by stem injection (Lucero presentation, May 2005).

Cut-stump - This method is often used on woody species that normally re-sprout after being cut. Cut down the tree or shrub, and immediately spray or squirt herbicide 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 therefore, has a low probability of affecting non-target species or contaminating the environment. It also requires only a small amount of herbicide to be effective.

The following methods are not included in the Proposed Action:

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

Biological Controls

Table 5 displays the biological control (biocontrol) agents currently released by Clallam, Grays Harbor, Jefferson, and Mason counties on the Olympic Peninsula to treat invasive plants. Releases and redistribution of these biological agents would be expected to occur regardless of alternative selected for this project, including No Action (Alternative A). Canadian Thistle Defoliating Beetle (*Cassida rubiginosa*) has been reported as distributed within adjacent counties. This biocontrol species has not been approved by the Animal and Plant Health Inspection Service (APHIS) and therefore may not be redistributed on the National Forest as per Standard 14.

Table 5-Biological Controls Currently Distributed on the Olympic Peninsula that Comply with Standard 14

Target Species	Biocontrol Agents
Purple Loosestrife	Purple Loosestrife Beetle (Galerucella calmariensis), Golden Loosestrife Beetle (Galerucella pusilla), Big Purple Loosestrife Weevil (Hylobius transversovittatus) and Little Purple Loosestrife Weevil (Nanophyes marmoratus)
Tansy Ragwort	Ragwort Flea Beetle (Longitarsus jacobaea)
Scotch Broom	Scotch Broom Seed Beetle (Bruchidius villosus), Scotch Broom Seed Weevil (Apion fuscirostre), or Scotch Broom Twig Miner (Leucoptera spartifoliella)
Knapweed	Seed Head Beetle (Larinus obtusus)
Canadian Thistle	Canadian Thistle Gall Fly (Urophora cardui)
St. John's Wort	Klamath Weed Beetle (Chrysolina quadrigemina)
Meadow Knapweed, Spotted Knapweed	Seed Head Gall Fly (Urophora quadrifasciata), Banded Gall Fly (Urophora affinis), Knapweed Root Moth (Agapeta zoegana) and Knapweed Root Weevil (Cyphocleonus achates)

Biological control agents undergo a rigorous testing procedure prior to initial release. Agents are tested for their effectiveness in controlling the target organism and for their host specificity. Testing includes potential effects on economic crops, rare plants, and similar species found in North America. An agent can be released only after it has been determined that it is unlikely that the agent will feed or cause injury to any native or agronomic species. It generally takes between ten and fifteen years for an agent to be cleared for release. The analyses for effects of such tools have already been completed under documents (including NEPA decisions) developed by APHIS for approval of entry of such organisms.

The APHIS analysis assumed that biological agents would spread throughout North America, to wherever the target species exists. Like the invasive plants that are targeted, biological agents do not recognize property boundaries. Biological agents are expected to spread onto National Forest System lands regardless of any action the Forest Service may take, including redistribution (agents moved from one location to another).

Similar to prevention, biological agents alone do not eradicate, control or contain invasive plants. However, both prevention and use of biological agents are part of the integrated management program and contribute to the goal of slowing the spread of invasive plants.

2.4 No Action

The No Action Alternative is also known as Alternative A

<u>Alternative A Description</u>

Total Acres to Be Treated: 672

Total Acres Estimated Herbicide Treatment: 86

Estimated Proportion of Herbicide Treatment Acres - Broadcast: 0%

Estimated Proportion of Herbicide Treatment Acres - Spot/Hand: 100%

Under Alternative A, the No Action alternative, invasive plant treatments would be implemented according to existing NEPA decisions, including the *Integrated Weed Management Program Environmental Assessment* (EA - 1998)/Decision Notice (DN - 1999) and APHIS approved biological controls released on the Olympic Peninsula. In addition, prevention practices would be integrated into all future projects to slow the spread of invasive plants throughout the National Forest.

The existing NEPA decisions allow for an integrated weed management strategy emphasizing prevention and control of invasive plants scattered across the Forest. The 1998 EA/1999Decision Notice approved manual, mechanical and herbicide treatments on 75 sites totaling approximately 672 acres.

Spot or hand herbicide treatments were prescribed on 86 acres, singly or in combination with manual or mechanical treatments. No broadcast treatments were approved. Available herbicides included glyphosate, dicamba and picloram, with aquatic glyphosate to be used in the vicinity of surface water.

The remaining 586 acres were proposed for manual and mechanical treatment. The 1999 EA included all inventoried invasive plant sites at that time.

No early detection/rapid response mechanism for new sites or adaptive management approaches for new methods were considered in the EA.

The No Action alternative would leave more than 80 percent of the currently infested acreage untreated.

Table 6-Alternative A - Acres by Treatment Combination

	Total Acres	Herbicide Only	Herbicide combined with Manual and/or Mechanical Treatment	Manual and Mechanical Only
Acres by treatment combination	672	0	86	586

2.5 The Proposed Action

2.5.1 Changes to the Proposed Action between Draft and Final

In response to public and interagency comments, PDFs and buffers have been adjusted in the Proposed Action.

The Proposed Action is also known as Alternative B.

Alternative B Description

Estimated Acres to Be Treated: 3,830

Total Acres Estimated Herbicide Treatment: 3,687

Estimated Proportion of Herbicide Treatment Acres - Broadcast: 34%

Estimated Proportion of Herbicide Treatment Acres - Spot/Hand: 66%

The Proposed Action (Alternative B) was developed to respond to the need for action by approving a range of treatment options to eradicate, contain, control and/or suppress the spread of invasive plants. The Proposed Action would allow treatment of the 672 acres included under No Action using new tools and approaches. It would also approve treatment on approximately 3,200 additional infested acres detected in the November 2004 inventory.

The Proposed Action would approve treatments based on common control measures (see table 10). Any of ten herbicides would be used according to Project Design Features and buffers listed in section 2.5.8.

About 85 percent of the infested acres are in roadside treatment areas. Broadcast application would be the most cost-effective method where the target plant density exceeds 70 percent cover, or where the distribution of target plants is continuous along the road. Project Design Features would eliminate the option of broadcasting on about 60 percent of the roadside treatment acreage.

2.5.1 Treatment Areas

Treatment areas are geographic assemblages of inventoried and anecdotal invasive plant sites that have been prioritized and prescribed for treatment. There are 99 treatment areas mapped; the majority of the infestations are along roadsides and other disturbed areas. Appendix A provides data tables corresponding to maps depicting the treatment areas.

Table 7-Infested Acres by Treatment Area Description

Treatment Area Description	Estimated Infested Acres
Roadside	3,270
Administrative Sites, Campgrounds, Summer Homes	130
Meadows, Wetlands and Floodplains	80
Trails	135
Forest	215
Total	**3,830**

2.5.2 Treatment Priority and Strategy

Each treatment area was also assigned an overall priority. The urgency, necessity, and intensity of treatment vary depending on priority, as shown in table 8. In general, higher priority treatments would be favored, and are most likely to be accomplished. Given current funding levels, lower priority treatments may not be accomplished, or may only be accomplished in connection with higher priority areas. Priorities on the Olympic National Forest are partially driven by the unique conditions here. Some invasive species that may be tolerated elsewhere may be targeted here, given the high value placed on natural habitats in wilderness areas, Research Natural Areas, Botanical Areas, tribal lands and the National Park.

Table 8-Treatment Priority and Strategy

Priority	Associated Treatment Strategy	Local Situations	Acres
Highest	All treatments in areas with potential for significant ecological impact New infestations of aggressive species when small	Botanical areas, Research Natural Areas, infestations in riparian areas and under a forest canopy.	620
Second	Eradication of aggressive species Treatment in areas of high public use and infestation potential (e.g. parking lots, campgrounds, trailheads, horse camps, gravel pits)	Roadside treatment areas with access to Olympic National Park. Treatment of Herb Robert, knotweeds, knapweeds, hawkweeds, butter and eggs, purple loosestrife. Meadows and administrative sites.	620
Third	Containment/control of existing large infestations of aggressive species with focus on boundaries of infestation.	Roadsides with access to areas of concern,	1,290
Fourth	Containment/control of remaining infestations.	Other roadsides.	1,300

Target species within each treatment area were assigned a treatment strategy. These strategies vary depending on the potential negative impacts of a given invasive species and the value or sensitivity of the treatment site (or adjacent lands) and are related to priority shown above. Treatment strategies considered for the Proposed Action include:[8]

- *Eradicate*: Totally eliminate an invasive plant species from a site. This objective generally applies to the hardest to control invasive species (Canada thistle, bull thistle, knapweed and knotweed) and highest-valued sites (e.g. wilderness and botanical areas).
- *Control*: Reduce the size of the infestation over time; some level of infestation may be acceptable. This objective applies to target species such as Scotch broom, English ivy and tansy.
- *Contain*: Prevent the spread of the weed beyond the perimeter of patches or infestation areas mapped from current inventories. This objective applies target species such as reed canary grass and St. John’s wort.

[8] Two other possible strategies exist: suppress and tolerate. Actions needed to meet these strategies are not the focus of this EIS.

Table 9 displays the number of acres proposed for each treatment strategy. Half of the proposed treatment acreage has a strategy of contain, which means that the outer perimeter of the treatment sites are likely to be treated, rather than the whole area.[9] Treatment cost estimates and assumptions vary by strategy (more information in Chapter 3.7).

Table 9-Acres by Treatment Strategy[10]

	Total	Eradicate	Control	Contain
Acres	**3,830**	420	1,475	1,930
Percent of Total	**100%**	11%	39%	50%

2.5.3 Common Control Measures

Table 10 summarizes the common control measures, including for herbicides, used to treat target invasive species known on the Olympic National Forest. Site-specific prescriptions would be refined for specific sites. Control measures may be updated through the life of the project as integrated control methods are refined and made more effective. Site-specific prescriptions would follow the Implementation Planning Process (2.5.7) and comply with Project Design Features and buffers (2.5.7).

New invasive plant sites (including new target species that do not appear in Table 10) found during the life of the project would be treated with similar control measures. Acreage is shown for target species where inventories indicate more than one acre of coverage. Some of the target species listed were not detected in the current inventory, but have the potential to be found on the Olympic National Forest.

Appendix B provides additional information about the control measures, including restoration emphasis items and manual disposal considerations. The full text of Appendix B is incorporated into the Proposed Action, however some control measures listed in table 10 or Appendix B may not be available in some locations due to the PDFs or because they are outside the scope of those analyzed in this EIS.

Implementation of the Common Control Measures would not "focus on the eradication of an invader but instead attempts to understand what makes it spread and focuses on reducing that spread through a combination of prevention, early detection/rapid response, treatment and restoration options. The main goal is to find the most effective methods with the least risk" (Appendix B-3).

[9] Acreage estimates include the entire infested area, and therefore overestimate the acreage that would actually be treated.
[10] The reason these acreages do not add up to the proportions shown above is that the treatment strategy is identified for each individual infestation, while priority is associated with the entire treatment area.

Table 10-Common Control Measures by Target Species

Target Species – Common Names, Scientific Names and Growth Habit	Acres from current inventory	Common Control Measures	Documented Effective Herbicides
Spotted knapweed (CEBI) *Centaurea biebersteinii* Diffuse knapweed (CEDI) *Centaurea diffusa* Meadow knapweed (CEDE) *Centaurea debeauxii* Brownray knapweed (CEJA) *Centaurea jacea* *Biennial or Perennial*	7	Manual treatments could be used for follow- up to herbicide. Hand pull or dig small populations or when regular volunteers are available. Multiple entries per year are required. Mowing is possible, but timing is critical. These treatments may take up to ten years due to long term seed viability.	***Clopyralid*** Picloram Glyphosate
Japanese knotweed (POCU) *Polygonum cuspidatum* Giant knotweed (POSA) *Polygonum sachalinense* *Perennial*	11	Herbicide treatment most effective. Use stem injection or foliar spray. If chemicals are used, manual treatments could be used for follow- up. Revegetate with desirable species if surrounding cover is primarily non-native.	Glyphosate, Triclopyr Imazapyr
Hawkweeds (HIPR, HIAU, HIVU) *Hieracium pratense, Hieracium aurantiacum, Hieracium vulgatum* *Perennial*	<1	Herbicide treatment is most effective. Some manual removal or covering with a plastic tarp possible for small infestations. If chemicals are used, manual treatments could be used for follow- up.	***Clopyralid*** Picloram Glyphosate
Butter 'n' eggs (LIVU2) *Linaria vulgaris* *Perennial*	<1	Hand pull or dig small populations or when regular volunteers are available. Cutting stems in spring or early summer will eliminate plant reproduction, but not the infestation. These treatments may take up to ten years due to long-term seed viability.	***Metsulfuron methyl*** ***Imazapic (in fall only)*** Glyphosate
Tansy ragwort (SEJA) *Senecio jacobaea* Common tansy (TAVU) *Tanacetum vulgare* *Biennial or perennial*	536	Hand-pulling is effective if done in moist soils, as a follow up to herbicide treatments are used to achieve initial control objectives.	Metsulfuron methyl Picloram Clopyralid Glyphosate

Target Species – Common Names, Scientific Names and Growth Habit	Acres from current inventory	Common Control Measures	Documented Effective Herbicides
Scotch broom (CYSC4) *Cytisus scoparius* *Perennial*	203	Hand pulling, cutting, weed wrenching or digging up of small populations or when regular volunteers are available or as a follow up to chemical use. Hand-pulling or weed wrenching is most effective in moist soils. Cutting will require multiple visits in one year. These treatments may take up to ten years due to long-term seed viability.	Triclopyr Clopyralid Picloram Glyphosate
English ivy (HEHE) *Hedera helix* *Perennial*	93	Manually remove infestations by removing vines first, than digging root mats from the soil. Vines must be cut at both the shoulder and ankle height, then stripped away from the tree. Work away from the tree pulling out the entire root mat for at least six feet. Apply herbicide in combination with string trimming.	Triclopyr Glyphosate
Reed canarygrass (PHAR3) *Phalaris arundinaceae* *Perennial*	156	Use a combination of herbicides and manual, mechanical, or cultural treatments. Manual treatments or mowing are only practical for small stands when multiple entries per year can be made. The entire population must be removed 2 to 3 times per year for at least five years. 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.	Sulfometuron methyl Glyphosate
Cheatgrass (BRTE) *Bromus tectorum* *Annual*	3	Hand-pulling is minimally effective and may take up to five years due to long-term seed viability. Repeated mowing (every three weeks) may help contain this species, especially as a follow up to herbicide use.	Imazapic Sethoxydim Sulfometuron methyl/ imazapyr (in fall only) Glyphosate
Canada thistle (CIAR4) *Cirsium arvense* *Perennial*	308	Herbicide treatment is most effective. The only manual technique would be hand cutting of flower heads, which suppresses seed production. 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.	***Clopyralid*** Picloram ***Chlorsulfuron*** Glyphosate (best in fall)
Herb Robert (GERO) *Geranium robertianum* *Annual, Biennial or Perennial*	10	Hand-pulling is most effective if the entire plant is pulled. Herbicides may also be used on larger infestations. Steaming/foaming may be an effective treatment.	Glyphosate
English holly (ILAQ80) *Ilex aquifolium* *Perennial*	<1	Use herbicides in combination with manual and mechanical techniques that remove lower and rooted branches.	Glyphosate
Purple loosestrife (LYSA2) *Lythrum salicaria* *Perennial*	<1	Herbicide treatment is most effective Hand removal of small populations or isolated stems is possible, but only if entire rootstock is removed. Hand cut flower heads to suppress seed production.	Glyphosate

Target Species – Common Names, Scientific Names and Growth Habit	Acres from current inventory	Common Control Measures	Documented Effective Herbicides
Himalayan blackberry (RUDI2) *Rubus discolor* Cutleaf blackberry (RULA) *Rubus laciniatus* *Perennial (canes die off annually)*	86	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 re-sprouting 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.	Triclopyr Glyphosate
Bull thistle (CIVU) *Cirsium vulgare* *Biennial*	600	Use manual, mechanical or chemical control or a combination. Any manual method that severs the root below the soil surface will 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.	***Clopyralid*** Picloram Glyphosate
St. John's wort (HYPE) *Hypericum perforatum* *Perennial*	341	Hand removal of small populations or isolated stems is possible, but repeated treatments will be necessary as lateral roots give rise to new plants. These treatments may take up to ten years due to long-term seed viability.	Metsulfuron methyl Picloram Glyphosate (not found as effective in the literature)
Oxeye Daisy (LEVU) *Leucanthemum vulgare* *Perennial*	505	Hand removal is possible, but only if entire rootstock is removed. Hand removal must be repeated for several years. Mowing is effective if repeated throughout the long growing season.	***Clopyralid*** Picloram Glyphosate (not found as effective in the literature)
Queen Anne's Lace (DACA6) *Daucus carota* *Biennial*	2	Small populations could be handpulled, but typically it is mowed along roadsides. A combination of mowing, then applying herbicide in late fall has been effective.	***Metsulfuron methyl*** Chlorsulfuron Glyphosate (not found as effective in the literature)
Narrow leaved plantain (PLLA) *Plantago lanceolata* *Perennial*	246	Can be handpulled or dug. Repeated treatments will be necessary. If chemicals are used, manual treatments could be used for follow-up. Out-competing through revegetation is the most effective treatment.	***Clopyralid*** Glyphosate
Creeping buttercup (RARE3) *Ranunculus repens* *Perennial*	6	Hand digging is effective. If chemicals are used, manual treatments could be used for follow- up.	Glyphosate

Target Species – Common Names, Scientific Names and Growth Habit	Acres from current inventory	Common Control Measures	Documented Effective Herbicides
Yellow nutsedge (CYES) *Cyperus esculentus* *Perennial*	15	Hand digging is effective if done before root tubers form. If chemicals are used, manual treatments could be used for follow-up. Out-competing through revegetation is the most effective means.	Glyphosate
Everlasting Peavine (LALA4) *Lathyrus latifolius* *Perennial*	<1	Herbicide treatment most effective. Hand control possible with repeated effort or combined herbicide/hand treatment. Hand removal must be repeated for several years.	Triclopyr Glyphosate Clopyralid Picloram/imazapyr (sites without grass cover)
Hairy cat's ear (HYRA3) *Hypochaeris radicata* *Perennial*	345	Herbicide treatment most effective. Hand removal is possible, and must be repeated for several years. If chemicals are used, manual treatments could be used for follow-up.	Clopyralid, Picloram Glyphosate
Big trefoil (LOPE80) *Lotus pedunculatus* *Perennial*	263	Herbicide treatment most effective. If chemicals are used, manual treatments could be used for follow-up.	Clopyralid or Picloram Triclopyr or Imazapyr (sites without grass cover) Glyphosate
English laurel (PRLA5) *Prunus laurocerasus* *Perennial*	<1	Hand pulling, cutting, girdling, weed wrenching or digging up of small plants is effective, especially when volunteers are available. Hand-pulling or weed wrenching is most effective when plants are small in moist soils. Herbicides cut and paint, stem injection, spot spray) may be used in combination with mechanical cutting or manual girdling. Annual re-treatment may be needed for several years to eradicate sprouts.	Triclopyr Glyphosate
Dandelion (TAOF) *Taraxacum officinale* *Perennial*	<1	Manual treatment for isolated individuals or small infestations using an appropriate digging tool designed to penetrate deep into the ground to remove the entire tap root. Do not hand pull as root fragments left behind will re-sprout. Covering plants with a tarp is an effective control method for seedlings. Mechanical treatment by mowing is not recommended as it can be beneficial to dandelions by reducing crowding/shading from surrounding vegetation. Herbicide treatment by spot spraying is effective.	Glyphosate

2.5.4 Treatment Site Restoration

Treatment site restoration is a component common to all action alternatives. Treatment site restoration may include mulching, seeding, and/or active revegetation, or may be passive in situations where desirable vegetation can naturally replace target invasive species removed. Treatment site restoration is part of the prescription developed during implementation planning. Restoration prescriptions would be influenced by site-scale conditions and broader land management objectives (for more information on restoration prescription process, see Appendix F, Excerpts from the 2003 *Draft Guidelines for Revegetation of Invasive Weed Sites and Other Disturbed Areas on National Forests and Grasslands in the Pacific Northwest).*

The analysis assumption is 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 evident surrounding the inventoried invasive plant populations known across the Olympic National Forest. 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.

Local native species are always preferred, but use of other desirable species such as non-native species that do not persist could be used as an interim step. A combination of native and desirable non-natives could be an initial mix for revegetation. A fast growing desirable non-native such as sterile wheatgrass can germinate quickly and start filling in bare ground until a slower to germinate native species can start competing effectively.

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 mycorrhizae would be added.

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. Shrubs allow for easier establishment of understory species by increasing water availability and reducing understory temperatures and evapo-transpiration. Planting of native shrubs may also occur in cases where rapid revegetation is desired; for example, native shrubs may be planted adjacent to summer homes around Lake Quinault to replace the non-native English laurel dominant there.

Appendix F is excerpted from an unpublished document (2003) *Draft Guidelines for Revegetation of Invasive Weed Sites and Other Disturbed Areas on National Forests and Grasslands in the Pacific Northwest.* This document provides further information on methods and guidelines for revegetation of invasive weed sites and disturbed areas. Steps are outlined for assessing existing and potential site conditions, and for developing long-term revegetation strategies that are effective, affordable, and consistent with the ecological context and land management objectives of the site and surrounding landscape. This document promotes the use of local native plant materials to establish competitive plant cover and meet the long-term objective to restore ecosystem functioning.

Appendix F was published in total in the Draft EIS and is available on the project website (find link at http://www.fs.fed.us/r6/olympic).

2.5.5 Proposed Herbicides and Additives

Table 11 displays typical application rates for herbicides proposed for use in the Proposed Action. The effective rate varies depending on many factors (application method, herbicide characteristics, target species, site conditions). The lowest effective rate would be used. Greater concentrations (rates) would be used infrequently and only where necessary to be effective. Lucero (personal communication, 2005) reported that stem injection with the highest application rates of glyphosate were required to effectively treat knotweed. In no case would herbicide concentrations be greater than maximum label rate and broadcast and spot applications within aquatic influence zones would never exceed typical rates (see PDFs below).

Table 11-Typical Herbicide Application Rates

Herbicide	Typical Application Rate Lbs. a.i./acre
Chlorsulfuron	0.056
Clopyralid	0.35
Glyphosate	2
Imazapic	0.13
Imazapyr	0.45
Metsulfuron Methyl	0.03
Picloram	0.35
Sethoxydim	0.3
Sulfometuron Methyl	0.045
Triclopyr	1.0

Herbicide Adjuvants (Additives) including Surfactants and Dyes

Several types of surfactants or additives have been reviewed in hazard and risk assessments and thus would meet Standard 18 of the R6 2005 ROD. Surfactants and other additives are used to help herbicides adhere to target plants and reduce drift (Bakke 2003). Dyes may be added during implementation to mark treated areas (ibid). Cationic, non-ionic, and silicon based surfactants; vegetable and crop oils; kerosene; and colorfast purple and hi-light blue dyes are discussed in Bakke's 2003 hazard assessment. Only those adjuvants that are approved by the Washington State Department of Agriculture (WSDA) and Department of Ecology (WSDOE) would be permitted within or immediately adjacent to streams. More information about herbicides and adjuvants is in Chapter 3.1.

2.5.6 Early Detection-Rapid Response Approach

The Early Detection/Rapid Response process allows for treatment "within the scope of the EIS" to occur on new, unknown, and unpredicted infestations found over the next five to fifteen years using treatment methods that are similar to those described in the EIS. The analysis for the Proposed Action considered treatment of 3,830 acres estimated as the current inventory. However, invasive plants are likely to spread to additional acreage beyond the current inventory within and outside mapped treatment areas. In addition, unknown infestations may currently exist.

Under the Early Detection/Rapid Response approach, new or previously undiscovered infestations would be treated using the range of methods described in this EIS, according to the Project Design Features listed later in this section. The Common Control Measures shown in Table 10 would be the starting point for a treatment prescription under the EDRR approach.

This approach is needed because 1) the precise locations of individual target plants, including those mapped in the current inventory are subject to rapid and/or unpredictable change and 2) the typical NEPA process would not allow for rapid response; infestations may grow and spread into new areas during the time it usually takes to prepare NEPA documentation.

The intent of the Early Detection/Rapid Response approach is to treat new infestations when they are small so that the likelihood of adverse treatment effects is minimized. The approach is based on the premise that the impacts of similar treatments are predictable, even though the precise location or timing of the treatment may be unpredictable.

The Early Detection/Rapid Response approach included in the Proposed Action allows the Forest Service to treat anywhere on the Forest that the need exists, based on, but not limited to the current inventory and anticipated rates of spread. The Implementation Planning process detailed in the following section is intended to ensure that effects are within the scope of those disclosed in this EIS; new situations that may have different effects would be subject to further NEPA analysis.

2.5.7 Implementation Planning Process

This section outlines the process that would be used to ensure that the selected alternative is properly implemented. The methodology follows Integrated Weed Management (IWM) principles (R6 2005 FEIS, 3-3) and satisfies pesticide use planning requirements at FSH 2109.14. It applies to currently known and new sites within or outside mapped treatment areas.

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 EIS.[11]

Develop site-specific prescriptions

- Use Integrated Weed Management principles to identify possible effective treatment methods.[12] Considerations include the biology of the target species and surrounding environment. Determine whether effective methods are within the scope of those analyzed in the EIS. [13] Prescribe herbicides as needed based on the biology of the target species and size of the infestations (for instance, manual treatment alone cannot effectively eradicate rhizomatous species).
- Broadcast application of herbicide would be considered for situations warranted by the density (approximately 70-80 percent cover) and/or the distribution (e.g. continuous target populations along a road) of invasive plants, unless limited by PDFs. Broadcast application would not occur on any road segments identified as having high potential to deliver herbicide to streams.
- Apply appropriate PDFs and buffers based on:
    - Range of effective treatments available, including herbicide (or mixture) and method of application[14]
    - The size of the infestation, its treatment history and response to past treatment

[11] Conditions throughout current treatment areas are assessed in Chapter 3 (more information in Appendix A). Treatment areas include all areas where spread could be predicted to occur, based on current infestations and possible vectors or spread. Treatment areas include established populations; new infestations could occur outside treatment areas. Early detection-rapid response is intended to allow for treatment of new infestations outside treatment areas. New treatment areas found during future inventories need to be evaluated for extraordinary site conditions that may trigger additional NEPA requirements.
[12] Table 10 displays a summary of current control measures for various target species. These methods are intended to be refined through monitoring and adaptive management
[13] If preferred methods have effects that are outside the scope of those analyzed in the EIS, additional NEPA would be required.
[14] A tank mixtures analysis, as described in Appendix B, would be conducted and Standard 16 criteria met if tank mixtures are prescribed.

  - Proximity to species of local interest or their habitats[15]
  - 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).
  - Additional considerations, such as weather conditions, can be found in the PDF section. Specialists will review and apply appropriate PDFs for the final site-specific prescription. For example, a fish biologist would review the annual program of work to ensure that appropriate buffer widths are included where fish species of local interest 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 PDFs are applied, further NEPA would be required to authorize the effective treatment.
- Review manual Scotch broom treatments to ensure no effect on heritage resources.
- Complete Form FS-2100-2 (see Appendix E), Pesticide Use Proposal. This form lists treatment objectives, specific herbicide(s) that would be used, the rate and method of application, and PDFs that apply.
- Confirm that surfactants proposed meet Standard 18.
- Confirm whether active restoration is likely to be needed (see Appendix F). Plan for acquiring seed, plant or mulch materials.
- Determine need for pre-project surveys for species of local interest and/or their habitats.
- Coordinate with adjacent landowners, water users, agencies, and partners.
- Document the elements of the public notification plan.
- Follow NMFS and FWS Reasonable and Prudent Measures and Terms and Conditions.

Accomplishment and Compliance Monitoring

- Develop a project work plan for herbicide use as per FSH 2109.14.3. This work plan presents organizational and operational details; including the precise treatment objectives; the equipment, materials and supplies needed; the herbicide application method and rate; field crew organization; 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, and site-specific PDFs. Include the appropriate PDFs, buffers, and approved surfactants in contracts and agreements.
- Document and report herbicide use and certified applicator information in the National pesticide use database, via the Forest Service Activity Tracking System (FACTS).[16]
- WSDA is the responsible agency for pesticide management. WSDA also holds the Non-Point Discharge permit for use of herbicides to control aquatic and/or emergent noxious weeds in Washington State.
- Implement the public notification plan and document accomplishments.

[15] The list of particular species of local interest would be defined during Implementation Planning. New listed or sensitive species may be added during the life of the project. Appropriate surveys and mitigation measures would be applied according to protocols current at the time of Implementation Planning.
[16] See Appendix E for forms.

Post-treatment Monitoring and Adaptive Management

- Post-treatment reviews would occur to determine whether treatments were effective, whether or not passive/active restoration is occurring as expected, and whether PDFs were appropriately applied. Non-target vegetation (e.g., botanical species of local interest) would be evaluated on sample sites before and after treatment, and two to three months later.
- Contract administration and other existing mechanisms would be used to correct deficiencies.
- Treatment accomplishments would be reported via the FACTS database. Herbicide use would be reported as required by the FSH 2109.14.
- Post-treatment monitoring would also be used to detect whether PDFs 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, all within the scope of the FEIS, 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 water bodies. Buffers may be adjusted for certain herbicides/application methods and not others, depending on results.
- Candidates for monitoring under the Regional Framework (R6 2005 ROD) would be submitted for higher risk situations such as emergent vegetation treatment or broadcast spray of aquatic labeled imazapyr and/or glyphosate within 100 feet of streams. Few higher risk situations currently exist.
- Additional monitoring may be included as part of the Olympic National Forest Annual Monitoring Plan or other ongoing programs such as state water quality monitoring.

2.5.8 Project Design Features and Buffers

The following Project Design Features (PDFs) are intended to reduce the potential impacts of invasive plant treatment and provide sideboards for early detection/rapid response and adaptive management.[17] The PDFs are based on site-specific resource conditions within the treatment areas, including (but not limited to) the current invasive plant inventory, the presence of special interest species and their habitats, potential for herbicide delivery to water, and the social environment. Implementation of the PDFs ensures that treatments would have effects within the scope of those disclosed in Chapter 3. All distances in the PDF and buffer tables are horizontal distances.[18]

For emphasis, some design features include herbicide label guidance and Forest Plan standards, however, not all Forest Plan standards or label directions are repeated here. Forest Plan standards and label directions would be followed, regardless of whether they are listed in the PDF table. Project Design Features were developed to minimize potential for significant adverse effects to such a degree that even though precise treatment locations may be uncertain, the character of the impacts can be predicted, and pose low risk to people and/or the environment. The Project Design Features avoid or minimize the potential for adverse effects.

[17] In this EIS, the terms project design feature and project Design Features are synonymous.
[18] This is a change from the DEIS, which assumed “slope” rather than “horizontal” or map distances.

The following steps were taken to generate the PDFs and buffers:

1. The November 2004 invasive plant inventory and database was developed to provide site-specific basis for the Proposed Action. Infested sites were aggregated into treatment areas. See Appendix A data tables that correspond to maps depicting each treatment area.
2. The range of site conditions encountered throughout the treatment areas were considered and analyzed the effects of applying a range of treatment prescriptions to these situations.

PDFs are summarized in table 12. Tables 13 – 16 show the herbicide use and protection buffers that would apply to streams and other water bodies, and botanical species of local interest.

The Project Design Features and buffers were updated in response to public comment and interagency consultation. Differences made in these tables between the Draft and Final EIS are noted in the tables. A specific risk assessment for the aquatic formulation of imazapyr (Habitat) has been completed and integrated into the FEIS effects analysis.

The FWS and NMFS BOs specify reasonable and prudent measures to minimize the likelihood of incidental take, along with non-discretionary terms and conditions to implement the reasonable and prudent measures. These measures do not substantively change the Proposed Action. See 2007 BOs and the ROD for more information

Table 12-Project Design Features

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
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.	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 ownerships.	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 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.
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 Olympic National Forest Plan and existing municipal agreements.

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
C - To Prevent the Spread of Invasive Plants During Treatment Activities			
C1	Where practical, clean vehicles and equipment (including personal protective clothing) prior to leaving treated areas or entering new areas.	To prevent the spread of invasive plants during treatment activities	Common measure
D - Wilderness Areas			
D1	No motorized equipment would be used in wilderness areas.	To maintain wilderness character and meet environmental standards.	Wilderness Act, 1990 Olympic 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 Olympic National Forest Plan
E - There are no Design Features under "E". These were mainly intended to protect aquatic habitats and were therefore moved to "H."			
F - Herbicide Applications			
F1a	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.	To limit potential adverse effects on people and the environment.	Standard 16, 2005 R6 ROD; Pesticide Use Handbook 2109.14
F1b	F1a and 1b were split out for reader's ease. 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, 2005 R6 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.	To limit potential adverse effects on people and the environment.	R6 2005 ROD Treatment Standards
F3	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. NPE surfactants do not pose similar risks to aquatic organisms and was therefore removed from this PDF.	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.

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
F4	The lowest effective application rates would be used for each given situation. NPE surfactant would not be broadcast at a rate exceeding 0.5 active ingredient per acre. 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. (pounds of active ingredient per acre).	To eliminate possible herbicide or surfactant exposures of concern to human health, and/or wildlife.	SERA Risks Assessments, Appendix Q of the R6 2005 FEIS
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 to non-target vegetation 100 feet or further from broadcast sites (see Chapter 3.2 for details).
G	**Herbicide Transportation and Handling Safety/Spill Prevention and Containment** 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.	FSH 2109.14, Bonneville Power Administration Biological Assessment, Buckhead Knotweed Project, Willamette NF Biological Assessment

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
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 DOA's 2003-2005 monitoring results. Source updated since DEIS.
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 and, in wetlands, near aquatic influence areas, especially adjacent to fish bearing streams; Species of Local Interest or their critical habitat: (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	To protect aquatic organisms by favoring lower risk methods where effective. Lower risk herbicides are preferred where effective. Non-herbicide, manual methods have the least potential for impact, therefore they would be preferred.	Herbicides were classed into low, moderate and higher risk to aquatic organisms based on SERA Risk Assessments.
H3	No use of picloram or Triclopyr BEE, and no broadcast of any herbicide on roadside treatment areas that have a high risk of herbicide delivery to surface waters (see Appendix D for a map and list of these roads).	To ensure herbicide is not delivered to streams in concentrations that exceed levels of concern. Not broadcasting far reduces potential for exposure because spot and selective method substantially reduce potential for off site impacts, drift, and other herbicide delivery mechanisms to water (runoff, leaching), No use of picloram and triclopyr BEE eliminates potential for these herbicides through the road ditch network.	SERA Risk Assessments, R6 2005 FEIS Fisheries Biological Assessment

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
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. Not broadcasting far reduces potential for exposure because spot and selective method substantially reduce potential for off site impacts, drift, and other herbicide delivery mechanisms to water (runoff, leaching), A restriction on herbicide selection avoids potential for herbicides to reach a threshold of concern.	SERA Risk Assessments R6 2005 FEIS and Fisheries Biological Assessment BPA Columbia River Biological Opinion
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.	BPA Columbia River Biological Opinion
H6	Avoid use of clopyralid on high-porosity soils (coarser than loamy sand).	To avoid leaching/ground water contamination.	Typical label advisory.
H7	Avoid use of chlorsulfuron on soils with high clay content (finer than loam).	To avoid excessive herbicide runoff.	Typical label advisory.
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.

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
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. Abates risks associated with worst-case scenarios and uncertainty regarding effects to reptiles and amphibians.	SERA Risk Assessments.
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. Abates risks associated with worst-case models for treatment of emergent vegetation.	SERA Risk Assessments.
H12	All wells and springs used for domestic water supplies would be protected with a 100 foot buffer for wells and a 200 foot buffer for springs. Follow label guidance relative to water contamination. This is a new PDF that responds to public concern for drinking water quality. The PDF related to "foaming" was removed because this method is currently not associated with treatments in Appendix A	Safe drinking water.	Label advisories and state drinking water regulations (Washington State WAC 246-290-315).
H13	With the exception of hand/select methods, herbicides would be applied at typical (or lower) rates within Aquatic Influence Zones. This is a new PDF to limit the application rate for spot and broadcast treatments in response to interagency comments.	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 6th field subwatershed in any given year. In addition, treatments below bankfull would not exceed 6 acres total within a 6th field sub-watershed in any given year. This is a new PDF to limit the application rate for spot and broadcast treatments in response to interagency comments.	Limits the extent of treatment within the Aquatic Influence Zone so that adverse effects are within the scope of analysis.	Analysis based on SERA risk assessment worksheets and emergent vegetation analysis completed for the Cranberry Bog and Middle Hoh River. Ten acres is based on GLEAM model factors.
H15	PDF H15 was in the DEIS but is omitted in the FEIS. The FS, FWS and NMFS are working together to address the need for rainfall delay specifications as a part of implementation planning.		
H16	Plan and schedule project activities to avoid disturbance of spawning fish or damage to redds. This is a new PDF in response to interagency comments.	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. This was previously PDF E2.	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.

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
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. This was previously PDF E3.	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.
I - Vascular and Non-Vascular Plant and Fungi Species of Local Interest			
I1	Adaptive management would be used to refine buffers to adequately protect perennial fungi, vascular and non-vascular plant Species of Local Interest (SOLI) and other non-target plants. Such species are on Regional Forester Sensitive Plant lists and Survey and Manage Species lists. This PDF has been reworded for clarity.	To prevent any repeated effects to SOLI populations, thereby mitigating any long-term effects.	Broadcast buffer sizes are based on Marrs, R.H., 1989, based on tests on vascular plants. Spot and hand/selective buffer distances are also based on reports from Cathy Lucero, Clallam County Noxious Weed Coordinator and other experienced herbicide applicators.
I2	Perennial fungi, vascular and non-vascular plant SOLI within 100 feet of planned broadcast would be covered by protective barrier, or broadcast application would be avoided in these areas (spot or hand herbicide treatment, or non-herbicide methods may be used).	To ensure SOLI are protected and surveys are conducted when appropriate.	Forest Service Manual 2670 Survey and Manage Species Direction.
I3	Perennial fungi, vascular and non-vascular plant SOLI within 10 feet of planned spot applications would be covered by protective barrier, or spot application would be avoided in these areas (hand herbicide treatment, or non-herbicide methods may be used). Under saturated or wet soil conditions present at the time of treatment, only hand application of herbicide is permitted within 10 feet of SOLI.	To ensure SOLI are protected and surveys are conducted when appropriate.	Forest Service Manual 2670 Survey and Manage Species Direction
I4	Prior to treatment, botanical surveys would occur as necessary to identify vascular and non-vascular plant and perennial fungi SOLI if unsurveyed suitable habitat is within 100 feet of planned broadcast treatments, 10 feet of planned spot treatments, and/or 5 feet of planned hand herbicide treatments (increased to 10 feet in saturated/wet soils).	To ensure SOLI are protected and surveys are conducted when appropriate.	Forest Service Manual 2670 Survey and Manage Species Direction
I5	Use special care when applying sulfonylurea herbicides due to their potency and potential to harm non-target vegetation. Do no use chlorsulfuron, metsulfuron methyl or sulfometuron methyl on dry, ashy, or light, sandy soils. This PDF was added to highlight the potential for these herbicides to harm non-target vegetation through dust or drift.	To protect non-target vegetation.	Label advisories.

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
J - Wildlife Species of Local Interest **Many of the Wildlife PDFs have been amended or supplemented as a part of Endangered Species Act Consultation with Fish and Wildlife Service.**			
J1-Bald Eagle			
J1a	Treatment of areas within 0.25 mile, or 0.50 mile line-of-sight, of bald eagle nests would be timed to occur outside the nesting season of January 1 to August 31, unless treatment activity is within ambient levels of noise and human presence (as determined by a local specialist). This seasonal restriction may be waived if a biologist determines by appropriate surveys that nest sites are not active that year.	To minimize disturbance to nesting bald eagles and protect eggs and nestlings	Bald Eagle Management Guidelines for OR-WA (Anonymous); U.S. Fish and Wildlife Service 2003, p. 9
J1b	Noise-producing activity above ambient levels would not occur between October 31 and March 31 within 0.25 mile, or 0.50 mile line-of-sight, of known winter roosts and concentrated foraging areas. Disturbance to daytime winter foraging areas would be avoided.	To minimize disturbance and reduce energy demands during stressful winter season	Bald Eagle Management Guidelines for OR-WA (Anonymous); Olympic National Forest Programmatic BO (U.S. Fish and Wildlife Service 2003, p. 9)
J2 - Spotted Owl			
J2	Chainsaw use within 65 yards, and mower or heavy equipment use within 35 yards, of any nest site, activity center, or un-surveyed suitable habitat will be timed to occur outside the early nesting season of March 1 to July 15, unless treatment activity is within ambient levels of noise and human presence (as determined by a local specialist). There is no seasonal restriction on the use of roadside broadcast sprayers.	To minimize disturbance to nesting spotted owls and protect eggs and nestlings	Olympic National Forest Programmatic BO (U.S. Fish and Wildlife Service 2003)
J3 - Marbled Murrelet			
J3a	Chainsaw or motorized tool use within 45 yards, and mower or heavy equipment use within 35 yards of any known occupied site or un-surveyed suitable habitat would will be timed to occur outside April 1 to August 5, unless treatment activity is within ambient levels of noise and human presence (as determined by a local specialist). There is no seasonal restriction on the use of roadside broadcast sprayers.	To minimize disturbance to nesting marbled murrelets and protect eggs and nestlings	Olympic National Forest Programmatic BO (U.S. Fish and Wildlife Service 2003)
J3b	After August 5 and before April 1, activities generating noise above 92 dB may occur within the disturbance distances listed above, but must still be conducted between 2 hours after sunrise and 2 hours before sunset.	To minimize disturbance to marbled murrelets returning to nest tree during the late breeding season.	Olympic National Forest Programmatic BO (U.S. Fish and Wildlife Service 2003)

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
J4 - Peregrine Falcon			
J4a	All invasive plant treatments would be seasonally prohibited within 0.5 miles of peregrine nest sites (primary nest zone). Invasive plant treatments involving motorized equipment and/or vehicles would be seasonally prohibited within 1.5 miles of known nest sites (secondary nest zones). This may include activities such as mulching, chainsaws, vehicles (with or without boom spray equipment) or other mechanically based invasive plant treatment. Non-mechanized or low disturbance invasive plant activities (such as spot spray, hand pull, etc.) may occur within the secondary nest zone, but would be coordinated with the wildlife biologist on a case-by-case basis to determine potential disturbance to nesting falcons and identify mitigating measures, if necessary.	To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest.	Pagel, J. (2006) Peregrine falcon nest site data, 1983-2006.
J4b	Seasonal restrictions would be waived within primary and secondary nest zones if the site is unoccupied or if nesting efforts fail and monitoring indicates no further nesting behavior.	To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest.	Pagel, J. (2006) Peregrine falcon nest site data, 1983-2006.
J4c	Seasonal restrictions would apply during the periods listed below based on the following elevations: Low elevation sites (1000-2000 ft) 01 Jan - 01 July Medium elevation sites (2001 - 4000 ft) 15 Jan - 31 July Upper elevation sites (4001+ ft) 01 Feb - 15 Aug Seasonal restrictions would be extended if monitoring indicates late season nesting, asynchronous hatching leading to late fledging, or recycle behavior which indicates that late nesting and fledging would occur.	To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest.	Pagel, J. (2006) Peregrine falcon nest site data, 1983-2006.
J4d	Protection of nest sites would be provided until at least two weeks after all young have fledged.	To protect falcon nest sites and fledglings.	Pagel, J. (2006) Peregrine falcon nest site data, 1983-2006.
J4e	Clopyralid would not be used within 1.5 miles of peregrine nest more than once per year. Picloram would not be used more than once every two years (see PDF H8).	To reduce exposure to hexachlorobenzene. This chemical has been detected in peregrine falcon eggs.	Pagel, J. (2006) Peregrine falcon nest site data, 1983-2006.

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
J5 - Van Dyke's, Cope's Giant, and Olympic Torrent Salamanders			
J5a	Avoid broadcast spraying of herbicide in talus or rocky outcrops, springs, seeps or stream margins. Utilize aquatic design features for suitable habitat in riparian areas, streams, and rivers.	To reduce likelihood of exposure to herbicides or additives from contaminated soil or water.	Herbicide characteristics and risk to amphibians in SERA risk assessments, and local biologist judgment.
J6 - Sensitive Mollusk Habitat, Burrington's and Warty jumping slugs			
J6a	In known sites or high potential suitable habitat outside of roadside treatment locations, avoid manual, mechanical, or herbicide treatments when soil moisture is high (generally late fall to late spring).	To reduce likelihood of trampling and herbicide exposure.	Herbicide characteristics in SERA risk assessments, and professional opinion of local taxa expert.
K - Public Notification			
K1	High use areas, including administrative sites, developed campgrounds, visitor centers, and trailheads would be posted in advance of herbicide application or closed. Areas of potential conflict would be prominently marked on the ground or otherwise posted. Postings would indicate the date of treatments, the herbicide used, and when the areas are expected to be clear of herbicide residue.	To ensure that no inadvertent public contact with herbicide occurs.	These are common measures to reduce conflicts.
K2	The public would be notified about upcoming herbicide treatments via the local newspaper or individual notification, fliers, and/or posting signs. Forest Service and other websites may also be used for public notification.	To ensure that no inadvertent public contact with herbicide occurs.	R6 2005 ROD Standard 23.
L - Special Forest Products			
L1	Triclopyr would not be applied to foliage in areas of known special forest products or other wild foods collection.	To eliminate any scenario where people might be exposed to harmful doses of triclopyr.	SERA Risk Assessments, Appendix Q of the R6 2005 FEIS
L2	Special forest product gathering areas may be closed for a period of time to ensure that no inadvertent public contact with herbicide occurs.	To eliminate any scenario where people might be exposed to herbicide.	R6 2005 ROD Standard 23 SERA Risk Assessments, Appendix Q of the R6 2005 FEIS
L3	Popular berry and mushroom picking areas would be posted prominently marked on the ground or otherwise posted.	To eliminate any scenario where people might be exposed to herbicide.	R6 2005 ROD Standard 23 SERA Risk Assessments, Appendix Q of the R6 2005 FEIS
L4	Special forest product gatherers would be notified about herbicide treatment areas when applying for their permits. Flyers indicating treatment areas may be included with the permits, in multi-lingual formats if necessary.	To ensure that no inadvertent public contact with herbicide occurs.	R6 2005 ROD Standard 23

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
M - Archeology and American Indian Rights			
M1	American Indian tribes would be notified annually as treatments are scheduled so that tribal members may provide input and/or be notified prior to gathering cultural plants. Individual cultural plants identified by tribes would be buffered as above for botanical species of local interest.	To ensure that no inadvertent public contact with herbicide occurs and that cultural plants are fully protected.	Government to government agreements between American Indian tribes and the Olympic National Forest
M2	The Forest Archaeologist will annually assess proposed treatment areas where minor ground disturbing actions such as weed wrenching and grubbing with a shovel in areas that are outside landslides, flood deposits, previously surveyed areas, skid trails, landings, road shoulders, cuts and fills, are proposed. The Forest Archaeologist will have an opportunity to review project locations to determine if any cultural resources could be affected. Weed wrenching and grubbing techniques will not be used in known archaeological sites. Alternative treatment methods will be selected from those that would have no potential to affect cultural resources. This PDF was added since the DEIS to ensure cultural resources are adequately protected.	To avoid conflicts impacts to cultural resources.	Common practice.

Herbicide Use Buffers

Herbicide use buffers in tables 13-15 act as a safety zone to keep herbicides from reaching levels of concern in surface waters. Broadcast methods are restricted near streams and wetlands. Aquatic labeled herbicides are available for use on emergent vegetation, through dry intermittent streams, and in ditches or other areas of likely delivery to surface water bodies.

Table 13-Herbicide Use Buffers – Perennial and Wet Intermittent Streams - Proposed Action (Alternative B)

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

*Changed from waters' edge to no buffer to allow for effective treatment of some target populations in stream islands using spot methods.

**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 14-Herbicide Use Buffers, Dry Streams

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

*The broadcast buffer increased to 50 feet to respond to public and interagency comments (see Appendix H).

Table 15-Herbicide Use Buffers – Wetlands/High Water Table/Lake/Pond - Proposed Action (Alternative B)

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

*This buffer was increased from 50 to 150 feet to ensure non-aquatic triclopyr is avoided throughout all Aquatic Influence Zones.
** If wetland, pond or lake is dry, there is no buffer.

Figure 1 illustrates how the Aquatic Influence Zone restricts application methods and herbicides to only those approved for use in aquatic areas. "Aquatic Influence Zone" is not equal to the "buffer widths" listed in the tables above. The Aquatic Influence Zone is defined by the innermost half of the Riparian Reserve, as defined by the Northwest Forest Plan. For instance, a 300 foot Riparian Reserve would have an Aquatic Influence Zone of 150 feet. Establishing buffer widths reduces the potential for herbicides to come in contact with water via drift, leaching, and runoff at or near concentrations of concern.

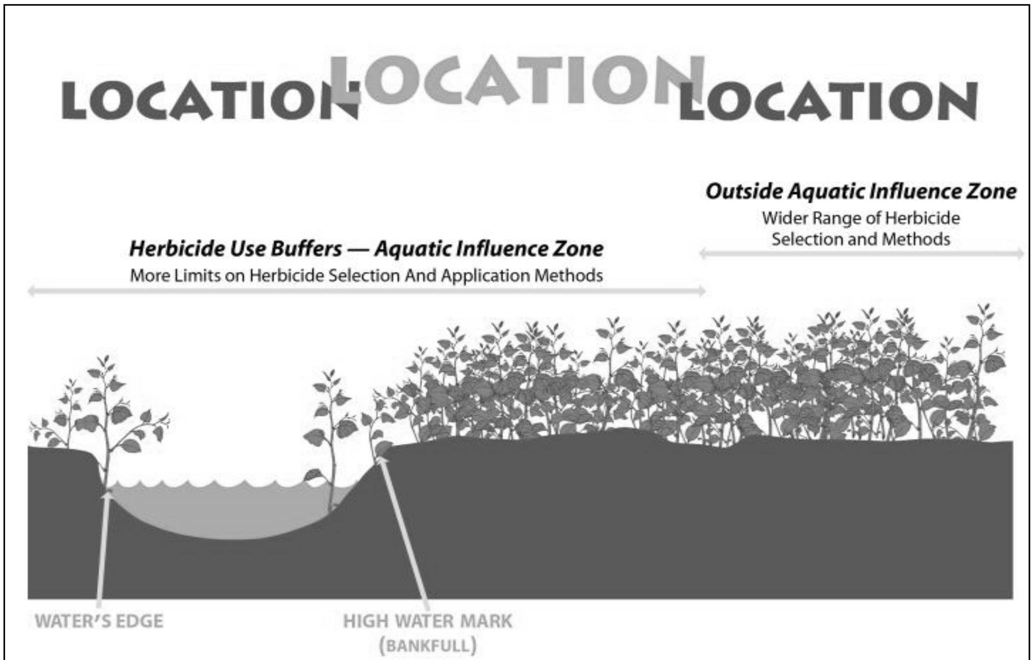

Figure 1-Schematic Showing Herbicide Use Buffers

Roadside Ditches

The illustration above in Figure 1 exemplifies a cross-section of either a stream or a roadside ditch that has a high potential for herbicide delivery. Roadside ditches can also act as extensions of the stream network when there is enough flow and depth in a ditch to deliver sediment. The analysis in this BA uses sediment delivery as a surrogate for potential herbicide delivery in roadside ditches. To reduce the potential for herbicides to come in contact with water via runoff at or near concentrations of concern, the following restrictions would apply to roadside treatments:

- No broadcasting of any herbicide on roads identified as a high potential for herbicide delivery (PDF H3)
- No use of picloram or Triclopyr BEE on roads identified as a high potential for herbicide delivery (PDF H3)
- Where there is standing water in a roadside ditch located outside the established buffers of a stream, apply a 15 foot buffer around the standing water and use only low risk herbicides 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 (PDF H4).
- Apply appropriate buffer widths to road sections that cross streams (refer to buffer tables above)

Table 16 displays the protection buffers specific to botanical species of local interest. These buffers are in addition to herbicide use buffers within Aquatic Influence Zones. Hence, if a botanical species of local interest is found at or near the edge of a stream buffer, then the stream buffer size may be enlarged to incorporate protection buffers established for botanical species of local interest.

Table 16-Protection Buffers for Botanical Species of Local Interest

	Distance from Species of Interest		
	Further than 100 ft.	**100 ft to 10 ft.**	**Closer than 10 ft.**
Application Method Allowed	All methods according to PDFs.	Botanical SOLI would be shielded with a protective barrier during broadcast herbicide application. No additional limitations for spot and hand/selective treatments	1. Broadcast application is not permitted. 2. If soils are saturated or wet at time of application, spot application is not permitted. Elsewhere, botanical SOLI would be shielded with a protective barrier during spot treatments. Hand application of herbicide and/or non-herbicide treatment permitted without protective shielding.

Design features for treatments closer than 5 feet from botanical SOLI were combined with design features for treatments 5 – 10 feet from botanical SOLI since the release of the DEIS. This change was made to simplify implementation.

2.5.9 Proposed Action Summary Table

Table 17 displays proposed treatment combinations based on the information gathered for existing infestations.

Table 17-Acres by Treatment Combination - Proposed Action (Alternative B)

Total Acres	Herbicide Only	Herbicide combined with Manual and/or Mechanical Treatment	Non-Herbicide Only
3,830	16	3,671	143

2.6 Alternative C - Less Herbicide Use Allowed

Alternative Description

Total Acres to Be Treated: 3,410

Total Acres Estimated Herbicide Treatment: 1,035

Estimated Proportion of Herbicide Treatment Acres - Broadcast: 0%

Estimated Proportion of Herbicide Treatment Acres - Spot/Hand: 100%

Alternative C is the Proposed Action, modified to further minimize (or eliminate) risks to soils, water and non-target organisms from the use of herbicides.

2.6.1 Treatment Areas, Priority and Strategy

Alternative C would approve treatment within the same treatment areas as the Proposed Action. However, Alternative C was modeled to treat 3,410 acres, omitting the 420 acres associated with a treatment strategy of "eradicate" in the Proposed Action. Fewer acres would be treated because treatments would tend to be less economically efficient and because eradication of invasive plant species would likely be impractical given the limitation on herbicide use inherent in this alternative.

2.6.2 Common Control Measures and Treatment Site Restoration

Alternative C would draw upon the same common control measures and treatment site restoration approach as the Proposed Action. Target species most effectively treated with herbicides would either not be treated or more time and money would be spent controlling or containing such species.

2.6.3 Implementation Planning and Early Detection-Rapid Response Approach

Alternative C would draw upon the same implementation planning and early detection-rapid response approach as the Proposed Action.

2.6.4 Herbicide Selection

Alternative C would allow for much less herbicide use overall (herbicides would not be used on more than two-thirds of the project area); however the slate of herbicides available would be the same as the Proposed Action.

2.6.5 Project Design Features and Buffers

All of the Project Design Features in the Proposed Action would be adopted except PDFs H1, H2, H3, H10, H 11, H 13, and H 14. Herbicides would generally not be used within Riparian Reserves[19] or within roadside treatment areas having high risk of herbicide delivery to streams under Alternative C. Broadcast treatments would not be approved anywhere on the National Forest (0% of the project area as compared to 34% for Alternative B).2.6.6 Alternative C Summary Table

Table 18-Total Acres by Treatment Combination – Alternative C

Total Acres	Herbicide Only	Herbicide combined with Manual and/or Mechanical Treatment	Non- Herbicide Only
3,410	0	1,035	2,375

[19] High priority species such as knotweed would continue to be treated as a part of ongoing prescriptions developed in partnership with other landowners and agencies. Such treatments would be very limited in extent (fewer than 10 acres)..

2.7 Alternative D – More Broadcast Allowed

Alternative Description

- ***Total Acres to Be Treated: 3,830***
- ***Total Acres Estimated Herbicide Treatment: 3,687***
- ***Estimated Proportion of Herbicide Treatment Acres - Broadcast: 84%***
- ***Estimated Proportion of Herbicide Treatment Acres - Spot/Hand: 16%***

Alternative D is similar to the Proposed Action except that more broadcasting would be allowed to increase the cost-effectiveness of treatments near dry streams and along roadside ditches.

2.7.1 Treatment Areas, Priority and Strategy

Alternative D would approve treatment within the same treatment areas as the Proposed Action. The priorities and strategies would also be the same as the Proposed Action.

2.7.2 Common Control Measures and Treatment Site Restoration

Alternative D would draw upon the same common control measures and treatment site restoration approach as the Proposed Action.

2.7.3 Implementation Planning and Early Detection-Rapid Response Approach

Alternative D would draw upon the same implementation planning and early detection-rapid response approach as the Proposed Action.

2.7.4 Herbicide Selection

Alternative D would allow for the same slate of herbicides as the Proposed Action.

2.7.5 Project Design Features and Buffers

All of the Project Design Features listed for Alternative B would be adopted, except for H3 (H3 restricts broadcasting of any herbicide, and any use of certain herbicides, on roads identified as having high risk of herbicide delivery to streams). In addition, buffers would not be implemented for dry streams (label restrictions would continue to apply). Under Alternative D, broadcast would be approved on a larger portion of the project area (84 percent as compared to 34 percent for the Proposed Action and 0 percent in Alternative C).

2.7.6 Alternative D Summary Table

Table 19-Total Acres by Treatment Combination – Alternative D

Total Acres	Herbicide Only	Herbicide combined with Manual and/or Mechanical Treatment	Non-Herbicide Only
3,830	16	3,671	143

2.8 Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Scoping input received in response to the Proposed Action provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives may have been outside the scope of this EIS, not meet the Purpose and Need for Action, not reasonably feasible or not viable, duplicative of the alternatives considered in detail, or were determined to cause unnecessary environmental harm. Therefore, the following alternatives were considered, but dismissed from detailed consideration for the reasons summarized in sections 2.8.1-2.8.3.

2.8.1 Preventing, Rather Than Treating Invasive Plants

Some comments expressed that the best approach for addressing invasive plant infestations is to eliminate disturbance caused by logging, grazing, road building, and vehicular traffic. These comments suggested that logging and other ground-disturbing projects should be suspended until a comprehensive EIS is completed that fully addresses the existing problem and 'root causes' of invasive plants. A similar issue was raised in the R6 2005 FEIS but dismissed from detailed study in the R6 2005 FEIS because "suspending multiple-use activities [would be] inconsistent with current laws governing the management of National Forest System lands" (R6 2005 FEIS page 2-33).

Prevention is an important component of invasive plant management addressed throughout the R6 2005 FEIS and ROD, additional national and regional manual direction and policy statements, and the USDA-Forest Service Guide to Noxious Weed Prevention. The R6 2005 ROD added a standard to all Forest Plans requiring that all land use projects, assessments and plans address prevention of invasive plant introduction, establishment and spread (Appendix 1). The Regional Forester intended the prevention standards to reduce rates of spread of invasive plants, while still maintaining the ability of the Forest Service to provide for existing uses and management activities on National Forest System lands (ROD page 9).

Invasive plant prevention practices will occur regardless of alternative selected for invasive plant treatment in this FEIS, including No Action. Washing equipment before entering the National Forest, scheduling activities to avoid moving between infested and uninfested areas, prompt revegetation of disturbed areas with native plants, managing off road vehicle use, and avoiding ground disturbance in certain areas are examples of current, ongoing invasive plant prevention practices.

Prevention is an important component of the integrated program, but without treatment, invasive plants will continue to spread. Recent work by Mehta et al 2007 found that early detection and rapid response increased managers' chances to successfully restore invasive plant sites and increases the effectiveness of prevention practices.

These invasive plant prevention practices are not connected actions to the proposed treatments. The focus of this FEIS is on the project level issues, alternatives, and effects related to invasive plant treatment and restoration of treated sites. NEPA regulations encourage such narrowing so that EIS's may be focused on issues that are ripe for decision:

> "Agencies are encouraged to tier their environmental impact statements to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision at each level of environmental review (§1508.28). Whenever a broad environmental impact statement has been prepared (such as a program or policy statement) and a subsequent statement or environmental assessment is then prepared on an action included within the entire program or policy (such as a site specific action) the subsequent statement or environmental assessment need only summarize the issues discussed in the

broader statement and incorporate discussions from the broader statement by reference and shall concentrate on the issues specific to the subsequent action" (40 CFR 1502.20).

In this case, the project analysis tiers to the broader scale R6 2005 FEIS regarding the issue of suspending land uses in order to prevent the spread of invasive plants.

2.8.2 No Herbicide Use

Additional public comments suggested that herbicide use should be severely minimized or eliminated altogether. The No Action alternative serves this function by allowing fewer than 100 acres of herbicide use (less than 2 percent of the current infested acres), which is very similar to a "no-herbicide" alternative. Alternative C was also developed to address public concerns about herbicide use by severely limiting herbicide use over about two-thirds of the Forest.

Both No Action and Alternative C rely mostly on manual and mechanical treatments. The impacts and effectiveness of such treatments are discussed in Chapter 3. If No Action were selected, future manual and mechanical treatments that have not already been approved would likely be categorically excluded from NEPA documentation.

2.8.3 Follow Herbicide Label Directions – No Additional Design Features

Public comments expressed a concern that Project Design Features proposed by the Forest Service are overly cautious and costly. All action alternatives must comply with new Forest Plan and other relevant invasive plant management direction. An alternative that only follows label directions may meet some, but not all of this management direction. In particular, all action alternatives must prescribe design features to minimize and/or eliminate adverse effects on non-target organisms. Chapter 3 describes how adverse effects may be avoided through application of design features. Alternative D is intended to allow the maximum flexibility in treatment options while still complying with management direction and standards.

2.9 Alternatives Compared

Table 20 displays similarities and differences between the alternatives. The alternatives mainly differ by how and where herbicides may be used. All of the alternatives (including No Action) include some herbicide use and allow for approved releases of biological controls. All of the action alternatives would allow for treatment of future detections of invasive plants and restoration of treated sites.

Table 20-Alternative Components Compared

Alternative Component	Alternative			
	A	B	C	D
Total Treatment Acres	672	3,830	3,410	3,830
Estimated Percentage of Current Infestation Treated	18%	100%	89%	100%
Acres of Proposed Herbicide Use	86	3,687	1,035	3,687
Estimated Proportion of Project Area Where Broadcast is Approved	0	34%	0	84%
Estimated Proportion of Project Area Herbicide Treatment Where Broadcast is not Approved	100%	66%	100%	16%
Includes approved existing biological releases	Yes	Yes	Yes	Yes
Includes Treatment of Future Detections	No	Yes	Yes	Yes
Includes Restoration Plan	No	Yes	Yes	Yes

Table 21 displays how each alternative addresses public issues described in Chapter 1.

Table 21-Alternative Comparison Relative to Issues

Issue	No Action (Alternative A)	Proposed Action (Alternative B)	Alternative C	Alternative D
1 – Human Health and Worker Safety 1a Exposure to Herbicides	No significant impact .	No plausible harm from herbicide exposure to workers or public.	Same as Alternative B	Same as Alternative B
1b – Drinking Water	No significant impact .	Drinking water would not be adversely affected.	Same as Alternative B	Same as Alternative B
2 - Treatment Strategy and Effectiveness 2a Herbicides Available for Use	3	10	10	10
2a Proportion of Infested Acres that May be Treated Using Herbicide	2 %	100%	30%	100%
2a Acres of Invasives in 2012 (assuming unlimited funding)	3,503	51	459	51
2b Long Term Strategy, Reduce Reliance on Herbicides Over Time	Long term strategy is not directly addressed in NEPA document	Active and passive restoration would be part of every prescription. Each year of treatment, as target population size is reduced non-herbicide methods would likely become more practical and effective.	Same as Alternative B.	Same as Alternative B
2c Treatment Priority	Treatment priorities are not directly addressed in NEPA document	Each treatment area has been given a priority, as shown in Chapter 2.5	Fewer treatment areas likely treated with equal budget.	More treatment areas likely treated with equal budget.
Issue Group 3 – Social and Economic 3a – Total Cost for the Most Ambitious Program over 5 years	$664,000	$2,183,000	$3,496,000	$2,070,000
Issue Group 3 – Social and Economic 3a – Average Annual Cost for the Most Ambitious Program over 5 years	$149,000	$490,000	$785,000	$465,000
Issue Group 3 – Social and Economic 3a – Average Cost Per Acre over a 5 year period	$988	$570	$1025	$540
Issue Group 3 – Social and Economic 3b – Jobs Associated with Treatments (per 6 month year)	8	18	54	13

Issue	No Action (Alternative A)	Proposed Action (Alternative B)	Alternative C	Alternative D
3c – Effects on Scenic, Recreation and Wilderness Values	No significant impact .	Containing, controlling and/or eradicating invasive plants would indirectly improve scenic, recreation and wilderness values. Project Design Features limit potential short term adverse impacts.	Less effectiveness in Riparian Reserve may result in increased risk to scenic, recreation and wilderness values in the long run.	Same as Alternative B.
3d – Special Forest Products and Gatherers	No significant impact .	Conflicts between treatments and gathering areas would be minimized. Inadvertent exposures would be minimized through newspaper or individual notification, fliers, and posting signs. No exposure exceeding thresholds of concern for people are plausible.	Same as Alternative B.	Same as Alternative B.
3e – Effects on Tribes, Civil Rights, Environmental Justice	No significant impact .	No disproportionate effects on any group of people, ongoing government-to-government consultation with tribes.	Same as Alternative B.	Same as Alternative B.
Issue Group 4 – Non-Target Plants And Wildlife 4a – Estimated Proportion of Project Where Broadcast Application is Approved	0%	34%	0%	84%
·Number of Plant Species of Local Interest Potentially Affected by Broadcast Herbicide Application Methods	0	0	0	0
Issue Group 4 – Non-Target Plants And Wildlife 4a – Potential Impact to botanical species of interest	No significant impact	No adverse effects on botanical species of local concern.	Same as Alternative B	Same as Alternative B
Issue Group 4 – Non-Target Plants And Wildlife 4b – Terrestrial Wildlife	No significant impact .	Not likely to adverse affect or impact wildlife species of local concern, including mollusks and salamanders.	Same as Alternative B	Same as Alternative B
Issue Group 5 – Effects on Soils, Water and Aquatic Organisms 5a – Effects on Soils	No significant impact .	Project Design Features avoid herbicide concentrations of concern in soils; limitations on herbicide selection depending on site-specific soil conditions.	Same as Alternative B, less use of herbicide.	Same as Alternative B, more potential broadcast of herbicide.
Issue Group 5 – Effects on Soils, Water and Aquatic Organisms 5b – Character of Herbicide Use Within Aquatic Influence Zones	Restricted to hand applications of aquatic glyphosate approved under current EA.	Risks from herbicide use within Aquatic Influence Zones and along roads having high risk of herbicide delivery are avoided or minimized through PDFs and buffers (see Chapter 2.5).	Same as Alternative A.	Fewer restrictions would apply to dry intermittent streams and roads with high risk of herbicide delivery to surface waters through ditch networks (see Chapter 2.7).

Issue	No Action (Alternative A)	Proposed Action (Alternative B)	Alternative C	Alternative D
5b – Estimated Acres Herbicide Use Within Aquatic Influence Zones	Fewer than 30 acres	Approximately 620 acres	Same as Alternative A.	Same as Alternative B.
5b – Estimated Proportion of Project Where Broadcast Application is Approved	0%	34%	0%	84%
5b – Estimated acreage where herbicide treatment may occur on roadside treatment areas with high potential to deliver herbicides	Fewer than 40 acres	1,420	0	1,420
5b – Estimated proportion of project where broadcast of herbicide may occur on roadside treatment areas with high potential to deliver herbicides	0	0	0	37%
5c - Potential for fish to be exposed to harmful concentrations of herbicide	Very Low	Low	Very Low	Moderate to high

Chapter 3. Affected Environment and Environmental Consequences

3.1 Introduction

3.1.1 The Project Area

The Olympic National Forest is comprised of 63 6th-field watersheds (a list of watersheds is displayed in the soil and water section later in this chapter) that cover over 1.8 million acres. Approximately one-third of the acreage within these watersheds lies on National Forest system lands. The Forest surrounds the Olympic National Park, and many of these watersheds originate there.

The Forest has a comparatively large number of streams and high rainfall. Approximately one-third of the project area lies within streamside Riparian Reserves (a land allocation from the Northwest Forest Plan – USDA/USDI 1994a).

3.1.2 Treatment Areas

Invasive plant sites have been inventoried and grouped into 99 treatment areas (see Appendix A). Of these, 16 treatment areas are in special land allocations: two treatment areas are within the Buckhorn Wilderness and 14 treatment areas are in designated botanical and/or Research Natural Areas (reference Forest Plan). Each treatment area contains a variety of site conditions that are more or less susceptible to the effects of invasive plants and/or their treatment.

Approximately 2,180 miles of roads cross the Forest. About 84 percent (3,270 acres) of the infestations are found within roadside treatment areas. Roadside type treatment areas include disturbed skid trails and landings within adjacent managed timber stands. Approximately 43 percent of the roadside treatment acres (1,420 acres) are estimated to occur along roads identified as high potential for herbicide delivery (Appendix D shows roadside treatment areas in relation to fish bearing streams).

3.1.3 Invasive Plants and Their Impact on Special Places

Approximately 30 invasive plants are inventoried on the Olympic National Forest. Infestations range in size from less than 1 to more than 200 acres within any single treatment area. Table 22 shows how treatment areas are classified.

Most invasive plants are predominantly located in disturbed areas: along road systems, in timber sale units (e.g., Matwat Timber Sale), at the Lake Quinault summer residences, in administrative sites (e.g., Dennie Ahl seed orchard, Snider Work Center, Hood Canal Ranger Station), in managed timber stands, and in areas utilized for recreation such as campgrounds, dispersed recreation, etc. (Quinault Loop Trail, Slab camp quarry, Seal Rock Campground, etc,). While most of the infestations are in disturbed areas (many invasive species do not grow well under a forest canopy), invasive species such as herb Robert, ivy and English holly can thrive in forested settings.

Table 22-Estimated Target Species Acres by Treatment Area Description

Treatment Area Description	Estimated Target Species Acres
Roadside	3,270
Administrative Sites, Campgrounds, Summer Homes	130
Meadows, Wetlands and Floodplains	80
Trails	135
Conifer Forest	215
Total Acres	**3,830**

Roads are conduits for the spread of invasive plants, providing for their transport and dispersal (e.g., seeds and vegetative reproductive parts attached to vehicles) and providing disturbed ground for easy colonization and establishment. Olympic National Forest System roads also serve to introduce invasive species onto the Olympic National Park, where native plant communities and ecological integrity are highly valued.

Roads serve to introduce and establish invasives in areas where they were previously unknown. For example, gorse has been found (and is being treated) on Quinault Indian Nation Lands on Highway 101. These control measures are especially important because gorse has not yet spread to Olympic National Forest System lands.

Timber harvest, road building, and other ground-disturbing activities occur on National Forest System lands and contribute to the spread of invasive plants, as the habitat conditions that facilitate colonization are created. Recreation activities (e.g. pack stock) can spread invasives along trail systems.

In addition, invasive plants are spread through the movement of water in creeks and across wetlands. Floods move invasive plant seed and materials into adjacent riparian areas.

Intentional and accidental introductions have occurred for centuries, but major introductions have occurred most rapidly over the past century. Introductions of invasive plants for forage (i.e. contaminated livestock feed), ornamental landscaping, road and dune stabilization, and erosion control have occurred throughout National Forest and adjacent lands in the Pacific Northwest. Most invasive plants have been introduced for horticultural use by nurseries, botanical gardens, and individuals (ibid.).

Commercial landscape nurseries in Washington sell, or once sold, exotic species for domestic landscaping that later were found to be invasive (e.g. butterfly bush, pampas grass, purple loosestrife, English ivy). These have been shown to spread to federal lands (ibid.).

On the Olympic National Forest, invasive plants have displaced native vegetation and disrupted the functioning of plant communities in many important areas, including (but not limited to):

- Meadow systems: Mint Meadow, Schmidt Knob, Savannah Restoration Site, Matheny Prairie;
- Buckhorn, Colonel Bob, Mt. Skokomish and the Brothers Wilderness Areas;
- Research Natural Areas: Wet Weather Creek, and Quinault Research Natural Area;
- Botanical Areas: Three Peaks, Matheny Ponds, Bill's Bog, North Fork Matheny Ponds, Matheny Ridge Alaska Yellow Cedar, Cranberry (sphagnum) Bog, Buckhorn, Three O'Clock Ridge, South Fork Calawah, Matheny Prairie, and Tyler Peak Botanical Area.

Without treatment, invasive plants will further displace native plant communities, and spread to new areas. In recent years, acres of invasives have increased at an average rate of 8 to12 percent each year; prevention practices were estimated to reduce that number by half (R6 2005 FEIS Chapter 4.2, page 4-24). Early detection of populations of invasive species is critical before they spread and become larger. As populations increase in number and size, they become more difficult and costly to control.

Appendix A-Treatment Area Information displays the invasive plant species that have been detected on the Olympic National Forest. The treatment acreage estimates in Appendix A have accounted for expected spread of invasive plants between the time of inventory and the first year of anticipated treatment under this EIS (2008).

3.1.4 Life of the Project and "Most Ambitious Treatment" Analysis Scenarios

This project would be implemented over several years as funding allows, until no more treatments were needed or until conditions otherwise changed sufficiently to warrant this EIS outdated. Site-specific conditions are expected to change within the life of the project, without necessitating further analysis: treated infestations will be reduced in size, untreated infestations will continue to spread, specific non-target plant or animal species of local interest could change, and/or new invasive plants could become established within the project area. The effects analysis considers a range of treatments applied to a range of site conditions to accommodate the uncertainty associated with the project implementation schedule.

Many variables affect invasive plant treatment prescriptions, including: land management objectives and standards related to a particular site; treatment area priority and treatment strategy (see Chapter 2 for more discussion about treatment areas, priorities and strategy); and landscape scale goals. The relative proportion and timing of integrated treatments including herbicides and other methods; the effectiveness of invasive plant management on neighboring lands; and available funding also affect the treatment that would be implemented.

Tables 23, 24 and 25 display the most ambitious annual treatment scenarios by alternative that form the basis for the analysis of economic efficiency, cost-effectiveness and environmental consequences and alternative comparisons. **They are not intended to be binding treatment prescriptions.**

Actual annual treatments will adapt to information gathered through inventory and monitoring and make the most of available funding. Newly discovered infestations could be prioritized over existing sites.

The most ambitious treatment scenario assumes a life of approximately 5 years. It would require a five to tenfold increase in funding compared to previous years (see the financial analysis later in Chapter 3.7). This funding level is not likely to be available; however, the most ambitious treatment scenario provides a consistent assumption for analysis purposes. The assumption of full funding allows the greatest and most intense impacts possible to be evaluated; however, both the positive and negative impacts of the project are likely to be less than predicted for the most ambitious conceivable treatment. However, analysis of the most ambitious conceivable treatment scenario clearly highlights the differences between the costs, effectiveness, and adverse effects from different treatment approaches.

The scenarios show how reliance on herbicides would be decreased over time. Non-herbicide methods are expected to become more effective over time, as populations have been substantially reduced. While not depicted in the charts, manual and mechanical treatments may occur instead, before or during herbicide treatment according to the Common Control Measures (see Chapter 2.5 and Appendix B) adapted to site conditions and experience.

These scenarios also assume that restoration is implemented as planned in the action alternatives. About 65 percent of the treated acres are assumed to require active restoration activity (mulching, seeding, planting) to reach desired conditions. Some restoration activities may actually be implemented before or during herbicide or non-herbicide treatments.

These scenarios are intended to portray the pattern of treatment. It illustrates concepts about restoration as part of the overall prescription, and demonstrates how reliance on herbicide methods would be decreased through the life of the project. The scenarios also emphasize that follow up is an absolute necessity to meet containment, control and/or eradication strategies.

These scenarios are not sensitive to the role of treatment priority and/or strategy (see Chapter 2.5 for more information on these variables, treatment strategy is factored into the Economic Analysis displayed in Chapter 3.7). The scenarios show all acreage treated in Year 1. In reality, the highest priority areas would most likely be treated first; lower priority infestations would continue to spread, increasing acreage where treatment may be needed.

No Action (Alternative A) Most Ambitious Treatment Scenario

As described in Chapter 2, No Action includes treatments that would occur under existing NEPA decisions. An EA completed in 1998 allowed for 672 acres of manual and mechanical treatment, of which 86 acres also included use of herbicides.

Between the years 2000-2001, approximately 2 acres of treatment with herbicide occurred per year, along with about 34 acres of manual/mechanical treatment.[20] The majority of the treatments involved repeated hand pulling of small roadside infestations of high priority species, such as spotted and meadow knapweed. Treatments were generally effective. However, some of the manual treatments used for species like scotch broom and tansy ragwort needed repeat treatments annually, and were not very cost effective.

In the year 2002, the budget increased four-fold, to approximately $80,000, due to Forest Service Title II funding to counties for cooperative efforts on invasive plant management of the National Forest and adjacent lands. From the years 2002 through 2005, the four counties on the Olympic Peninsula participated in invasive plant treatments on National Forest system land averaging about 130 acres/year of manual treatment. In 2005, the Forest accomplished herbicide treatments for two Japanese knotweed infestations (2 acres) according to the 1998 EA.

For the purposes of analysis, No Action assumes that all 672 acres are treated in year 1 (86 acres with spot/hand herbicide applications followed by manual and mechanical treatment plus 586 acres of manual and mechanical treatment). Each year, 25 percent fewer acres are assumed to need re-treatment based on the relative estimated effectiveness of each year's work. No specific restoration plan was included, thus no applicable estimate could be made for acres restored. The assumptions built into No Action for the most ambitious treatment scenario would require a two-fold increase in funding (compared to current estimates), thus actual effectiveness may be less than predicted.

[20] Low acreages overall resulted from small budgets in these years (about $20,000 per year) and concerns about the adequacy of NEPA documents supporting herbicide use. Budgets have increased and are expected to continue to grow once this EIS is completed and action is approved. No Action is assumed to have a low effectiveness ranking due to its limited use of herbicide (see Botany and Treatment Effectiveness section below).

Table 23-Most Ambitious Annual Treatment Scenario – Alternative A

Treatment Scenario	Year 1	Year 2	Year 3	Year 4	Year 5
Total Acres Treated	672	504	378	284	213
Acres Treated with Herbicide	86	65	49	37	28
Acres Treatment With Non-Herbicide	586	439	329	247	185
Acres Active Restoration (mulch, seed, plant)	NA	NA	NA	NA	NA

Alternative B Most Ambitious Treatment Scenario

Under Alternatives B all 3,830 estimated infested acres would be treated in Year 1, which would be assumed to reduce infestation size by 80 percent (see Botany and Effectiveness section later in this Chapter). Each year, 80 percent fewer acres would need to be re-treated, until Year 5, when desired conditions for all known infestations would be assumed to be achieved. Alternative B has an effectiveness ranking of 80 percent because it allows a relatively wide range of treatment options available at a given site.

For the purposes of analysis, under Alternative B, the project would be concluded within 5 years assuming the most ambitious treatment scenario. In reality, some infestations may still need to be treated after five years if there is a persistent seed bank. As invasive plant populations get significantly smaller, non-herbicide methods would become more cost-effective. Thus, the proportion of non-herbicide compared to herbicide methods would increase over time. **The most ambitious treatment scenario would require a five-fold increase in funding over a five-year period.**

Table 24-Most Ambitious Annual Treatment Scenario – Alternative B

Treatment Scenario	Year 1	Year 2	Year 3	Year 4	Year 5
Total Acres Treated	3,830	765	148	29	0
Acres Treated with Herbicide	3,687	544	62	0	0
Acres Treated With Non-Herbicide	143	221	86	29	0
Percentage of treatments that are non-herbicide	4%	29%	58%	100%	NA
Acres Restored Passive or Active (mulch, seed, plant)	0	958	958	958	958

Alternative C Most Ambitious Treatment Scenario

Under Alternative C, sites having a treatment strategy of "eradicate" would not be treated.[21] This would leave about 3,410 acres to be treated in year 1. The analysis assumes that treatments using herbicides would reduce infestation size by 80 percent annually, similar to Alternatives B and D. Treatments in areas having an herbicide use restriction would reduce infestation size by 25 percent annually, similar to Alternative A.

[21] This assumption was included to emphasize how eradication of aggressive target species may require herbicides to accomplish, and the restrictions on herbicide use inherent to Alternative C would not allow the Forest Service to fully accomplish this strategy.

Table 25-Most Ambitious Annual Treatment Scenario - Alternative C

Treatment Scenario	Year 1	Year 2	Year 3	Year 4	Year 5
Total Acres Treated	3,410	1979	1133	657	381
Acres Treated with Herbicide	1,035	600	333	193	112
Acres Treated With Non-Herbicide	2,375	1379	800	464	269
Percentage of treatments that are non-herbicide	70%	70%	70%	70%	70%
Acres Restored Passive or Active (mulch, seed, plant)	0	853	853	853	853

Alternative D Most Ambitious Treatment Scenario

The most ambitious treatment scenario associated with Alternative D is exactly the same as the scenario for Alternative B. The differences between these alternatives do not affect the most ambitious scenario or balance between herbicide and non-herbicide treatments through the 5 years that were modeled.

Most Ambitious Treatment Scenario Alternative Comparison

Table 26 displays the acreage that would be treated using herbicide, manual and mechanical methods each year under the most ambitious conceivable program. These scenarios would result in the greatest predicted level of treatment effectiveness and the maximum potential for adverse effects of treatment.

The most ambitious conceivable treatment scenario assumes treatment begins in 2007.[22] Due to delays in completing Endangered Species Act Consultation for federally listed aquatic species, the project would not begin until 2008. Throughout this FEIS, when addressing the life of the project, please add one year to the estimates to account for the delay.

Table 26-Most Ambitious Annual Treatment Scenario - Alternative Comparison

Year	Treatment Acres (Most Ambitious Conceivable Treatment Scenario)		
	Alternative A	Alternatives B and D	Alternative C
2007	672	3,830	3,410
2008	504	765	765
2009	378	148	148
2010	284	29	29
2011	213	0	0

Relationship of Analysis Scenarios to Early Detection-Rapid Response

All action alternatives include the ability for Forest Service land managers to approve treatments on currently unknown invasive plant sites assuming Project Design Features would be followed. The premise of early detection-rapid response analysis approach is that treatments of new infestations according to methods and design features defined in this project-level EIS will have similar effects to treatments of existing sites.

Assuming the most ambitious conceivable treatment scenario under each alternative, early detection/rapid response would be expected to be a very small part of the program, because so much of the current inventory would be treated in year 1.

[22] This analysis assumed implementation would begin in 2007. Due to delays associated with consultation under the Endangered Species Act, implementation is now scheduled to begin in 2008. All dates associated with the life of the project would be advanced by one year.

If the most ambitious treatment scenarios were not implemented, over time, early detection-rapid response would tend to become a larger part of the program. The acreage treated in any one year would not likely exceed the most ambitious treatment scenario analyzed because the most ambitious scenario is already five to ten times the current budget, which makes a more ambitious program extremely unlikely.

Even if the acreage treated in one year were to exceed the most ambitious treatment scenario, the effects analysis would still be valid, because the Project Design Features (PDFs) and Implementation Planning process described in Chapter 2 ensure that the plausible adverse effects of treating currently unknown infestations would be within the scope of those disclosed here. Section 3.1.5 provides further reasoning about how PDFs minimize or eliminate herbicide exposure scenarios of concern to people and the environment.

3.1.5 Herbicide Risk Assessments and Layers of Caution

Information from laboratory and field studies of herbicide toxicity, exposure, and environmental fate was used to estimate the risk of adverse effects to non-target organisms. Formal risk assessments were done by Syracuse Environmental Research Associates, Inc (SERA) using peer-reviewed articles from the open scientific literature and current Environmental Protection Agency (EPA) documents, including Confidential Business Information.

They considered worst-case scenarios including accidental exposures and application at maximum label rates. The risk assessments meet the requirements of the Pesticide Use Handbook, FSH 2109.14 Chapter 20.

The R6 2005 FEIS added a margin of safety to the SERA Risk Assessments by making the thresholds of concern substantially lower than normally used for such assessments (see R6 2005 FEIS Appendix P for details). Although the risk assessments have limitations (see R6 2005 FEIS pages 3-95 through 3-97), they represent the best science available. Table 27 displays the risk assessments that may be accessed via the Pacific Northwest Region website at http://www.fs.fed.us/r6/invasiveplant-eis/Risk-Assessments/Herbicides-Analyzed-InvPlant-EIS.htm.

The herbicides on the list are those listed in Standard 16 that was approved in the R6 2005 ROD. They were selected because they are the lowest risk herbicides that are effective against the full range of target species known within Region 6 (ROD page 23).

Table 27-Herbicide Risk Assessments

Herbicide	Date Final	Risk Assessment Reference
Chlorsulfuron	November 21, 2004	SERA TR 04-43-18-01c
Clopyralid	December 5, 2004	SERA TR 04 43-17-03c
Glyphosate	March 1, 2003	SERA TR 02-43-09-04a
Imazapic	December 23, 2004	SERA TR 04-43-17-04b
Imazapyr	December 18, 2004	SERA TR 04-43-17-05b
Metsulfuron methyl	December 9, 2004	SERA TR 03-43-17-01b
Picloram	June 30, 2003	SERA TR 03-43-16-01b
Sethoxydim	October 31, 2001	SERA TR 01-43-01-01c
Sulfometuron methyl	December 14, 2004	SERA TR 03-43-17-02c
Triclopyr	March 15, 2003	SERA TR 02-43-13-03b
NPE Surfactant	May 2003	USDA Forest Service, R-5 (Bakke 2003)

In addition to the analysis of potential hazards to human health from every herbicide active ingredient, Forest Service/SERA Risk Assessments evaluated available scientific studies of potential hazards of other substances associated with herbicide applications: impurities, metabolites, inert ingredients, and adjuvants. There is usually less toxicity data available for these substances (compared to the herbicide active ingredient) because they are not subject to the extensive testing that is required for the herbicide active ingredients under FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act). However, EPA has not classified any of the inerts as toxic. Some of the inerts are approved food additives (for instance, glacial acetic acid, monoethanolamine and isopropyl alcohol).

Additives, Impurities and Inert Ingredients

Inert compounds are those that are intentionally added to a formulation, but have no herbicidal activity and do not affect the herbicidal activity. Inerts are added to the formulation to facilitate its handling, stability, or mixing. Impurities are inadvertent contaminants in the herbicide, usually present as a result of the manufacturing process. Adjuvants are compounds added to the formulation to improve its performance.

Adjuvants can either enhance the activity of an herbicide's active ingredient (activator adjuvant) or offset any problems associated with its application (special purpose or utility modifiers). Surfactants are one type of adjuvant that makes the herbicide more effective by increasing absorption into the plant, for example. Many of the inert ingredients are proprietary in nature and have not been tested on laboratory species. However, confidential business information (i.e. the identity of proprietary ingredients) was used in the preparation of the herbicide risk assessments (see Chapter 3.1 for more information on the risk assessment process and terminology).

Of the adjuvants approved for us on National Forests in Washington, two carry the Danger signal word (Entry™ II and LI-700®), due to the potential effects to the eyes (severely irritating or corrosive). None of these adjuvants carry the poison symbol.

All of the adjuvants discussed here are no more than slightly toxic when ingested, inhaled, or absorbed through the skin (Acute Toxicity Categories III or IV) and none of these adjuvants contain ingredients found on U.S. EPA's inerts list I or II (known to be hazardous). The primary known hazard to these surfactants is skin and eye irritation. Health risks are minimized by following industrial hygiene practices.

At certain rates, NPE and POEA surfactants have been shown to have adverse effects on human health and aquatic ecosystem elements. Therefore, use of POEA surfactants is not proposed where delivery to water is possible, and rates of NPE are restricted, especially in areas of special forest products.

Available information for inerts contained in the proposed herbicides is as follows:

Chlorsulfuron – The identity of inerts used in chlorsulfuron are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003 Chlorsulfuron). EPA has not classified any of the inerts as toxic. These inert ingredients do not affect the assessment of risk.

Clopyralid – Identified inerts include monoethanolamine and isopropyl alcohol, both approved food additives. These inert ingredients do not impact the assessment of risk

Glyphosate – There are at least 35 glyphosate formulations that are registered for forestry applications (SERA, 2003 Glyphosate) with a variety of inert ingredients. SERA obtained clearance to access confidential business information (i.e. the identity of proprietary ingredients) and used this information in the preparation of the risk assessment. Surfactants (discussed below) were the only additives identified that impact risk (SERA, 2003 Glyphosate).

Imazapic - The identity of inerts used in imazapic formulations are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003 Imazapic). None of the inerts are classified by EPA as toxic.

Imazapyr **–** The NCAP website (http://www.pesticide.org/FOIA/picloram.html) identifies only glacial acetic acid as an inert ingredient. Isopropanolamine is also present, and it is classified as a List 3 inert.

Metsulfuron methyl - The identity of inerts used in metulfuron methyl formulations are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003 Metsulfuron methyl). None of the inerts are classified by EPA as toxic.

Picloram - Tordon K and Tordon 22K contain the following inerts: potassium hydroxide, ethoxylated cetyl ether, alkyl phenol glycol ether, and emulsified silicone oil (NCAP website; http://www.pesticide.org/FOIA/picloram.html). Potassium hydroxide is an approved food additive. The other compounds are all on EPA's List 4B, inerts of minimal concern. They may also contain the surfactant polyglycol 26-2, which is on EPA's List 3: Inerts of Unknown Toxicity, discussed in the following section. The toxicity data on the formulations encompasses toxic risk from the inerts. Inerts in picloram formulations do not appear to pose a unique toxic risk (SERA, 2003 Picloram).

Sethoxydim - The formulation Poast contains 74 percent petroleum solvent that includes naphthalene. The EPA has placed this naphthalene on List 2 ("agents that are potentially toxic and a high priority for testing"). Petroleum solvents and naphthalene depress the central nervous system and cause other signs of neurotoxicity (SERA, 2001).

Poast has also been reported to cause skin and eye irritation. There is no information suggesting that the petroleum solvent has a substantial impact on the toxicity of sethoxydim to experimental animals, with the important and notable exception of aquatic animals (SERA, 2001). Poast is much more toxic to aquatic species than sethoxydim.

Sulfometuron methyl - The identity of inerts used in Oust are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003 Imazapic). None of the inerts are classified by EPA as toxic. Based on comparison of the toxicities of the active ingredient and the formulation, there is no reason to suspect that Oust contains other ingredients that substantially affect the potential risk to the environment.

Triclopyr - Formulations contain ethanol (Garlon 3A) or kerosene (Garlon 4), which are known to be neurotoxic. However, the toxicity of these compounds is less than that of triclopyr, so the amount of ethanol and kerosene in these formulations is not toxicologically significant (SERA, 2003 Triclopyr). The amount of inert ingredients in the formulations is generally not known, so exposure and dose estimates cannot be calculated.

Surfactants

The following types of surfactants have been reviewed in risk assessments and may be used to help herbicides adhere to target plants (Bakke 2003). Trade name examples are also provided. Surfactants help reduce drift and abate risk of off site movement of herbicides.

The effects of using these ingredients, along with other inerts and metabolites, have been disclosed in the R6 2005 FEIS (Chapters 4.4, 4.5, 4.7 along with Appendices P and Q; and the Biological Assessment prepared for ESA consultation).

Limitations are proposed for use of some surfactants associated with potential adverse effects on human health, wildlife and aquatic ecosystem elements (see discussions in Chapter 3).

Ethoxylated fatty amines (Cationic)

Entry™ II (Monsanto Company)

POEA (Polyethoxylated Tallow Amine - Roundup® (non-aquatic glyphosate) has 15% POEA. The POEA is associated with adverse effects on aquatic ecosystems. These risks are abated by project design features.

Alkylphenol and Alcohol ethoxylate-based surfactants (non-ionic)

R-11® Spreader Activator (Wilbur-Ellis Company)

Activator 90 (Loveland Industries)

X-77® (Loveland Industries)

Latron AG-98™ (N) (Dow AgroSciences LLC)

Cide-kick®, Cide-kick® II™ (Brewer International)

These surfactants usually include an alcohol as a solvent (isopropanol (X-77®, AG-98™), butanol (R-11®, AG-98™ (N)), glycol (AG-98™ (N), Activator 90)), a silicone defoamer (polydimethylsiloxane) and water.

Activator N.F. (Loveland Industries)

Nonylphenol Polyethoxylate (NPE) is a common non-ionic surfactant associated with some risks to human health and the environment. These risks are abated by project design features.

Silicone-Based Surfactants

Also known as organosilicones, these are increasing in popularity because of their superior spreading ability. This class contains a polysiloxane chain. Some of these are a blend of non-ionic surfactants (NIS) and silicone while others are entirely silicone. The combination of NIS and a silicone surfactant can increase absorption into a plant so that the time between application and rainfall can be shortened.

Sylgard® 309 (Wilbur-Ellis Company) –silicones

Freeway® (Loveland Industries) –silicone blend

Dyne-Amic® (Helena Chemical Company) - silicone blend

Silwet L-77® (Loveland and Helena) - silicones

Blends normally include an alcohol ethoxylate, a defoamer, and propylene glycol.

Oils

Surfactants that are primarily oil-based have been gaining in popularity especially for the control of grassy weeds. Oil additives function to increase herbicide absorption through plant tissues and increase spray retention. They are especially useful in applications of herbicides to woody brush or tree stems to allow for penetration through the bark. Oil adjuvants are made up of either petroleum, vegetable, or methylated vegetable or seed oils plus an emulsifier for dispersion in water.

Vegetable Oils – The methylated seed oils are formed from common seed oils, such as canola, soybean, or cotton. They act to increase penetration of the herbicide. These are comparable in performance to crop oil concentrates. In addition, silicone-seed oil blends are also available that take advantage of the spreading ability of the silicones and the penetrating characteristics of the seed oils.

The U.S. Food and Drug Administration (FDA) consider methyl and ethyl esters of fatty acids produced from edible fats and oils to be food grade additives (CFR 172.225). Because of the lack of exact ingredient statements on these surfactants, it is not always clear whether the oils that are used in them meet the U.S. FDA standard.

MSO® Concentrate Methylated Seed Oil (Loveland Industries)

Hasten® (Wilbur-Ellis Company)

The surfactant in Pathfinder™ II (a triclopyr formulation)

Improved JLB Oil Plus (Brewer International)

Cide-Kick and Cide-Kick II (Brewer International)

Blends of vegetable oils and silicone-based surfactants

Syl-tac™ (Wilbur-Ellis Company)

Phase™ (Loveland Industries)

Crop Oils and Crop Oil Concentrates

These are normally derivatives of paraffin-based petroleum oil. Crop oils are generally 95-98 percent oil with 1-2 percent surfactant/emulsifier. Crop oils also promote the penetration of a pesticide spray. Traditional crop oils are more commonly used in insect and disease control than with herbicides. Crop oil concentrates are a blend of crop oils (80-85 percent) and a nonionic surfactant (15-20 percent). The purpose of the nonionic surfactant in this mixture is to emulsify the oil in the spray solution and lower the surface tension of the overall spray solution. Kerosene is found in the triclopyr formulation Garlon IV. This formulation would not be broadcast nor used within 150 feet of surface water bodies or wetlands.

Adjuvants Approved For Riparian Areas

Adjuvants that are approved for used in the immediate Aquatic Influence Zone in Washington State (see table 28 below) meet the following criteria:

- The product must fulfill all requirements for registration of a food/feed use spray adjuvant in Washington
- The spray adjuvant must be either slightly toxic or practically non-toxic to freshwater fish (such as rainbow trout, coho salmon or other cold water species)
- The spray adjuvant must be moderately toxic, slightly toxic or practically non-toxic to aquatic invertebrates (such as Daphnia spp.)
- The spray adjuvant formulation must contain less than 10% alkylphenol ethoxylates (including phosphate esters)

Table 28-Products Meeting Standard 18 That Are Approved by WSDA For Use Near Surface Waters

Product Name	Registrant	Principal Functioning Agent	Risk/Hazard Assessment
Agri-Dex	Helena Chemical Company	Petroleum Oil, polyoxyethylene sorbitant fatty acid ester, sorbitant fatty acid ester	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

Herbicide Toxicology Terminology

The following terminology is used throughout this chapter to describe relative toxicity of herbicides proposed for use in the alternatives.

Exposure Scenario: The mechanism by which an organism (person, animal, fish) may be exposed to herbicides active ingredients or additives. The application rate and method influences the amount of herbicide to which an organism may be exposed.

Threshold of Concern: A level of exposure below which there is a low potential for adverse effects to an organism. Effects on wildlife and other organisms are considered insignificant and discountable when herbicide exposure is below the threshold of concern.

Hazard Quotient (HQ): A "toxicity threshold" was established for each herbicide (and NPE) to indicate the point below which adverse effects would not be expected for a variety of organisms (e.g. people, wildlife, fish). The predicted level of exposure from herbicide use is compared to the toxicity threshold and expressed in terms of a "hazard quotient (HQ)". The HQ is the result (quotient) of the exposure estimate divided by the toxicity threshold. Toxicity thresholds are based on extrapolated laboratory results and accepted scientific protocols. In Region 6, the toxicity thresholds were lowered to account for risk to federally listed species, following protocol used by EPA (EPA 2004, p. 46). An HQ less than or equal to 1 indicates an extremely low level of risk. An HQ above 1 does not necessarily indicate a level where adverse effects are likely, however, the probability of harmful effects increases with HQ.

Layers of Caution Integrated Into Herbicide Use

Figure 2 displays the layers of caution that are integrated into herbicide use in the Pacific Northwest Region (Region Six). First, label requirements, federal and state laws, and the EPA approval process provide an initial level of caution regarding chemical use. Next, the SERA Risk Assessments disclosed hazards associated with worst-case herbicide conditions (maximum exposure allowed by the label).

The R6 2005 FEIS included an additional margin of safety by reducing the level of herbicide exposure considered to be of concern to fish and wildlife (see Appendix P – Summary of Herbicide Effects to Wildlife for further explanation). Herbicides such as 2,4-D and Dicamba were not approved for use in the R6 2005 ROD (page 23) and restrictions on application method for many herbicides were included in Standard 16 (ibid.).

At the project scale, additional layers of caution would be integrated into herbicide use in both action alternatives:

1. Treatment methods would be limited to those necessary to eradicate, control or contain invasive plants on the Olympic National Forest; no aerial treatment is proposed and broadcast application would be limited to certain areas or prohibited altogether.
2. Project Design Features (PDFs) under the Proposed Action and Alternative C[23] would ensure proposed herbicide exposures do not exceed thresholds of concern for people and botanical, wildlife, and aquatic Species of Local Interest (see Effects Thresholds in table 29 below). This is true for known infestations as well as those found in the future, because the PDFs serve to limit the rate, type and method of herbicide application sufficiently to eliminate exposure scenarios that would cause concern, based on the site conditions at the time of treatment. Further analysis would be required if a new infestation would not be treated effectively according to the PDFs (for instance, the herbicides available for use near streams were not effective for a new infestation).
3. The implementation planning and monitoring processes described in Chapter 2 ensure that effective treatments are completed according to PDFs and undesired effects are indeed minimized.

Table 29 displays the relative properties, risks and uses of each herbicide and indicates some of the PDFs that address toxicological concerns by limiting application rate and herbicide exposure. Herbicide properties and risks adapted from R6 2005 FEIS (pg. 3-91),

[23] Alternative D incurs some risk of exceeding thresholds of concern. .

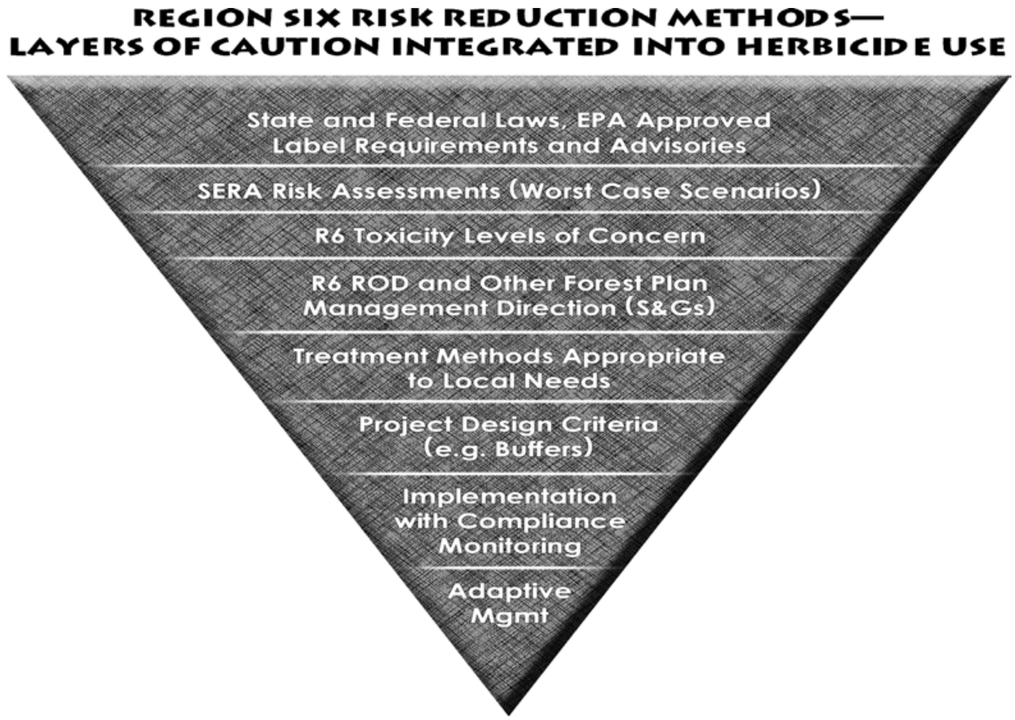

Figure 2-Region Six Layers of Caution in Herbicide Use

Table 29-Herbicides Ingredients, Properties, General Uses and Design Features for Herbicides

Active Ingredient Selected Herbicide Brand Names and Mode of Action	Properties	General Uses/ Known to be Effective on:	Risks	Design Features to Minimize or Eliminate Risks
Chlorsulfuron (Telar, Glean, Corsair) Sulfonylurea-Interferes with enzyme acetolactate synthase with 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 Dalmatian toadflax and houndstongue.	Moderate risk to aquatic organisms.	H-7 Avoid use of chlorsulfuron on soils with high clay content (finer than loam). I-5 Use special care around non-target vegetation. Do not use on dry, ashy, or light, sandy soils H-2 Application of chlorsulfuron is the second to last choice within roadside treatment areas having high risk of herbicide delivery and, in wetlands, near aquatic influence areas, especially adjacent to fish bearing streams. H-4 No use within 15 feet of wet roadside ditches.
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.	Contains hexachlorobenzene (persistent carcinogen) in amounts below a threshold of concern this substance is ubiquitous in the environment. Highly mobile, but does not degrade in water. Lower risk to aquatic organisms.	H-6 Avoid use of clopyralid on soils with high clay content (finer than loam).

Active Ingredient Selected Herbicide Brand Names and Mode of Action	Properties	General Uses/ Known to be Effective on:	Risks	Design Features to Minimize or Eliminate Risks
Glyphosate (35 formulations, including RoundUp, Rodeo, Accord XRT, Aquamaster, 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. Trans-locates to roots and rhizomes of perennials. While considered non-selective, susceptibility varies depending on species. Main control for purple loosestrife, herb Robert, English ivy and reed canary grass. Aquatic labeled formulations can be used near water.	Non-selective. Greater risk to aquatic organisms.	Aquatic labeled glyphosate may be used within the bankfull channel Aquatic Influence Zones, which poses inherent risk of delivery to water. Along with buffers that restrict method of application, design features intended to keep herbicide from entering water in concentrations above a threshold of concern include: H-10 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. H-11. 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. H-13 With the exception of hand/selective treatment methods, herbicide application within the Aquatic Influence Zone would not exceed typical label rates. H-14 Treatments above bankfull and within the aquatic influence zone (riparian area), would not exceed 10 acres along any 1.5 mile of stream reach within a 6th field subwatershed in any given year. In addition, treatments below bankfull would not exceed 6 acres total on an annual basis per 6th field sub-watershed.
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	More potential to kill non-target vegetation. Lower risk to aquatic organisms.	Follow label advisories and apply botanical buffers. No selected PDFs for aquatic organisms.

Active Ingredient Selected Herbicide Brand Names and Mode of Action	Properties	General Uses/ Known to be Effective on:	Risks	Design Features to Minimize or Eliminate Risks
Imazapyr (Arsenal, Arsenal AC, 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.	More potential to kill non-target vegetation. Moderate risk to aquatic organisms. Human health hazard associated with higher label rates. More mobile.	F-4 Do not exceed a rate of 0.70 lb active ingredient (a.i.)/acre with broadcast and spot applications. Aquatic labeled imazapyr may be used within Aquatic Influence Zones, which poses inherent risk of delivery to water. Along with buffers that restrict method of application, PDFs intended to keep herbicide from entering water in concentrations above a threshold of concern include: H-10 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. H-11. 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. H-13 With the exception of hand/selective treatment methods,, herbicide application within the Aquatic Influence Zone would not exceed typical label rates. H-14 Treatments above bankfull and within the aquatic influence zone (riparian area), would not exceed 10 acres along any 1.5 mile of stream reach within a 6th field subwatershed in any given year. In addition, treatments below bankfull would not exceed 6 acres total on an annual basis per 6th field sub-watershed.
Metsulfuron methyl (Escort XP) Sulfonylurea - Inhibits acetolactate synthesis, protein synthesis inhibitor, and blocks 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). Safest sulfonylurea around non-target grasses.	Use at low rates to control such species as houndstongue, sulfur cinquefoil perennial pepperweed plant.	More potential to kill non-target vegetation. Lower risk to aquatic organisms.	I-5 Use special care around non-target vegetation. Do not use on dry, ashy, or light, sandy soils

Active Ingredient Selected Herbicide Brand Names and Mode of Action	Properties	General Uses/ Known to be Effective on:	Risks	Design Features to Minimize or Eliminate Risks
Picloram (Tordon K, Tordon 22K) 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, toadflaxes, sulfur cinquefoil, and hawkweeds. Provides control of new germinants for two to three growing seasons.	Most mobile, but persistent in soil. Contains hexachlorobenzene (persistent carcinogen) in amounts below a threshold of concern this substance is ubiquitous in the environment. More potential to kill non-target vegetation. Greater risk to aquatic organisms. Human health hazard associated with higher label rates.	H-8 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. H-3 No use of picloram… on roadside treatment areas that have a high risk of herbicide delivery. H-4 No use within 15 feet of wet roadside ditches.
Sethoxydim (Poast, Poast Plus) Inhibits acetyl co-enzyme, a key step for synthesis of fatty acids.	A selective, post-emergent grass herbicide.	Would control many annual and perennial grasses such as cheatgrass.	Greatest risk to aquatic organisms.	H-2 Application of sethoxydim is the last choice within roadside treatment areas having high risk of herbicide delivery and, in wetlands, near aquatic influence areas, especially adjacent to fish bearing streams: H-4 No use within 15 feet of wet roadside ditches.
Sulfometuron methyl (Oust, Oust XP) 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 reed canary grass, cheatgrass, and medusahead.	Persistent in soil. Toxic to soil organisms. More potential to kill non-target vegetation. Moderate risk to aquatic organisms. Human health hazard associated with higher label rates.	H-9 Avoid use on shallow or coarse soils (coarser than loam.) No more than one application within a one-year period, except to treat areas missed during initial application. I-5 Use special care around non-target vegetation. Do no use on dry, ashy, or light, sandy soils.

Active Ingredient Selected Herbicide Brand Names and Mode of Action	Properties	General Uses/ Known to be Effective on:	Risks	Design Features to Minimize or Eliminate Risks
Triclopyr (Garlon 3A, Garlon 4, Forestry Garlon 4, Pathfinder II, Remedy, Remedy RTU, Redeem R&P) Synthetic auxin - Mimics natural plant hormones.	A growth regulating selective, systemic herbicide for control of woody and broadleaf perennial invasive plants. Little or no impact on grasses.	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	Greatest risk to aquatic organisms. Exposure may exceed thresholds of concern for workers and the public.	F-2 Comply with R6 2005 ROD requiring spot and hand/selective treatments only. L-1 Triclopyr would not be applied to foliage in areas of known special forest products or other wild foods collection. H-3 No use of …Triclopyr BEE, … on roadside treatment areas that have a high risk of herbicide delivery Aquatic labeled triclopyr may be used up to 15 feet from surface waters. Additional PDFs intended to keep herbicide from entering water in concentrations above a threshold of concern include: H-10 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. H-11. 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. H-13 With the exception of hand/selective treatment methods,, herbicide application within the Aquatic Influence Zone would not exceed typical label rates. H-14 Treatments above bankfull and within the aquatic influence zone (riparian area), would not exceed 10 acres along any 1.5 mile of stream reach within a 6th field subwatershed in any given year. In addition, treatments below bankfull would not exceed 6 acres total on an annual basis per 6th field sub-watershed

3.1.6 Basis for Cumulative Effects Analysis

As defined by 40 CFR 1508.7 and 1508.8, and FSH 1909.15 Section 15.1, A cumulative effect is the effect on the environment that results from the incremental effect of the action when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the other actions and regardless of land ownership on which the other actions occur. An individual action when considered alone may not have a significant effect, but when its effects are considered in sum with the effects of other past, present, and reasonably foreseeable future actions, the effects may be significant.

The Olympic National Forest surrounds the Olympic National Park and shares some watersheds with the park, along with tribal and other lands. The Forest Service manages about one-third of the lands within 6^{th}-field watersheds containing National Forest (a list of watersheds is displayed in the soil and water section later in this chapter). Actions on neighboring lands can contribute to the containment of invasive plants on National Forests (and visa versa).

The following roads within National Forest treatment areas provide access to/from adjacent non-Forest lands and are likely vectors of invasive plant spread between different ownerships: 2180, 22, 2294, 2340, 2464, 2610, 2902, 2918, 2920, 2922, 2923, 30, 3006, 3006400, and 3116.

The National Forest portions of these roads are proposed for treatment in the action alternatives. Treatment effectiveness would be increased if adjacent lands were also treated.

Invasive plants are managed on private and public lands throughout the analysis area. Treatments on and off National Forest system lands would be coordinated using existing mechanisms such as Weed Management Areas and interagency coordination with the counties and the US Park Service, and government-to-government consultation with American Indian tribes.

Cumulative effects analysis throughout this chapter considers whether there are significant additive, synergistic or offsetting effects of other past, present, and foreseeable future actions in combination with the proposed project. Herbicides are widely used for agricultural and industrial forest management, landscaping, and invasive plant management. Herbicide use occurs on Quinault tribal lands, the Olympic National Park, state and county lands, private forestry lands, rangeland, utility corridors, and road rights of way.

No central source exists for compiling invasive plant management information off National Forests within Washington. There is no requirement for landowners or counties to report invasive plant treatment information, thus an accurate accounting of the cumulative acreage of invasive plant treatment for all land ownerships is unavailable. The National Park Service reported treating fewer than 100 acres of invasive plants with herbicide over the past several years (Acker, personal communication, 2006).

Although many herbicides are registered by the U.S. Environmental Protection Agency for use in agriculture, most are not used in forestry. Forestry uses account for less than one percent of the total herbicides or pesticides used in the United States of America (Norris et al. 1991).

The potential for adverse effects of the use of the proposed herbicides is fairly small (see table 29). While workers, the public, wildlife and/or fish may be exposed to herbicides within and outside the Olympic National Forest, multiple exposures do not necessarily equate to cumulative adverse effects. The herbicides proposed for use are water-soluble, are rapidly eliminated from humans and do not concentrate in fatty tissues and do not significantly bioaccumulate (R6 2005 FEIS). This is true whether an organism is exposed to one or several of the chemicals proposed for use.

Table 30 displays the baseline, spatial and temporal scales considered for cumulative adverse effects for each resource area. The EIS considers the effects of each alternative when combined with past, ongoing or future proposed actions. These actions may occur on or off National Forest lands. Cumulative adverse effects can occur if one or more activities occur close enough in time and space for impacts to be combined.

Table 30-Baseline and Scales for Botany, Wildlife, Soils, Water Quality, Aquatic Organisms and Human Health

Resource	Baseline (existing condition)	Spatial Scale	Temporal Scale
Botany	Current extent of botanical species of local interest is the baseline for effects comparison. No known threats to botanical SOLI from past and ongoing herbicide use in the analysis area.	Treatment effects are localized. All methods pose some risk of harming non-target botanical species. Mistakes can be made with all tools. Herbicide may drift or run off up to 15 – 100 feet from treatment site depending on application method.	Impacts to non-target vegetation would occur at the time of treatment. Localized residual effects to vegetation are possible with longer-lived herbicides such as picloram and clopyralid.
Wildlife	Current extent of habitats for wildlife species of local interest is the baseline for effects comparison. No known threats to wildlife SOLI from past and ongoing herbicide use in the analysis area.	Treatment effects are localized. Herbicide may drift or run off up to 15 – 100 feet from treatment site depending on application method. Extent of treatment extremely low compared to extent of available habitats.	Chronic exposure to low levels of herbicide is possible over the life of the project. The herbicides proposed for use are metabolized and excreted faster than they can accumulate in the bodies of animals.
Soils	Current soil inventory is the baseline. No adverse effects on soils from past and ongoing herbicide use in the analysis area.	Treatment effects are localized. Herbicide may drift or run off up to 15 – 100 feet from treatment site depending on application method.	Herbicides vary as to persistence in soils. Picloram, clopyralid and sulfometuron methyl are residually active in soil.
Water Quality	Baseline for comparison is current water quality. No streams within analysis area listed for chemical contamination.	Cumulative effects are considered at the 6th field watershed scale. Treatments of emergent and riparian target and treatments along roads that have high potential to deliver herbicide to surface water bodies are areas where cumulative deliveries to streams are possible.	Herbicides may be persistent in water for months after treatment however quantities are far below amounts that would cause harm.
Aquatic Organisms	Baseline for comparison is current extent of fish species of local interest. No known threats to aquatic SOLI from past and ongoing herbicide use in the analysis area.	Acute exposure is considered at the site-scale. Acute exposure is evaluated along a stream approximately 1.5 miles long. Acute exposure in a discrete contiguous wetland is also evaluated at the treatment area scale.	Potential acute effects are evaluated over the course of 24 hours. After that, there is no potential for concentrations to exceed a level of concern. The herbicides proposed for use are metabolized and excreted faster than they can accumulate in the bodies of aquatic animals.
Human Health	Baseline for comparison is the current situation. No known threats to human health from past and ongoing herbicide use in the analysis area, however most humans are subject to some background level of chemical exposures.	Direct and indirect effects of treatment limited to 15 – 100 feet from treatment site.	People may be exposed to herbicide in a chronic manner (e.g. applicators) or through multiple exposure mechanisms (breath, skin, ingestion of contaminated meat, mushrooms or fruit). The herbicides proposed for use are metabolized and excreted faster than they can accumulate in human bodies.

The Project Design Features (PDFs) displayed in Chapter 2 for the Proposed Action constrain the rate and method of herbicide use to such a degree that the likelihood of adverse effects occurring is low. Adverse effects from acute, multiple or chronic exposures are unlikely. Chronic exposures do not exceed thresholds of concern because the herbicides are excreted from organisms so rapidly that they do not accumulate over time.

The PDFs limit the mechanisms by which workers, the public, non-target plants, wildlife and fish may be exposed to herbicides. The PDFs were developed considering the risks and properties of the herbicides proposed for use. Herbicide selection and/or method are restricted depending on the toxicity, mobility, and persistence of each chemical applied to a range of site conditions.

The PDFs sufficiently minimize risks to compensate for inherent uncertainty about the impacts of herbicide use on neighboring lands. In watersheds where the majority of acreage is administered by the Forest Service, the likelihood of cumulative effects is low because less than one percent of the total watershed acreage would be treated. As the portion of National Forest system lands decreases, the plausible contribution of Forest Service to the overall chemical load within the watershed also decreases. Either way, herbicide use within the scope of this EIS has little potential for cumulative effects, whether in the context of proposed treatment at any one site or total chemical exposure in any 6th-field watershed.

Early detection-rapid response is part of all action alternatives, and considered in the direct, indirect and cumulative effects analysis. Effects of treatments each year under early detection-rapid response, by definition, would not exceed those predicted for the most ambitious conceivable treatment scenario. This is because the Project Design Features do so much to minimize or eliminate the potential for adverse effects, whether all acreage was treated in a single year, or whether less acreage was treated in a single year and treatments occurred over a longer period of time. Effects of treatments under early detection-rapid response would be sufficiently minimized by the PDFs regardless of when the treatments occurred. If effective treatments of new infestations required methods outside the scope of the project, or if PDFs could not be applied without a significant loss of effectiveness, further analysis would be necessary prior to treatment.

Table 29 provides a link between the herbicides properties and risk and specific design features intended to minimize adverse effects. Glyphosate, imazapyr and triclopyr have more associated design features because aquatic formulations of these herbicides may be used near water bodies.

3.2 Botany and Treatment Effectiveness

This section focuses on the relative likelihood that the treatment methods approved in each alternative would be effective in reducing threats to non-target vegetation from invasive plants (Issue Group 2). This section also discloses the risks to non-target vegetation, especially Botanical Species of Local Interest, from the treatment of invasive plants (Issue Group 4).

In general, the threats from invasive plants to non-target vegetation are greater than the threats from treatment. As treatment effectiveness increases, the threats to native vegetation decrease. Broadcast herbicide treatments can be the most cost-effective of the methods considered in this EIS, and while this method poses the greatest risk to non-target vegetation, Project Design Features would mitigate the risks. Adequate measures are in place to mitigate the risk of broadcast treatments occurring in proximity to Botanical Species of Local Interest; monitoring is recommended to manage uncertainty related to the potential effect of herbicide drift on certain non-vascular plants.

3.2.1 Affected Environment

Invasive plants have been detected on 3,830 acres of the Olympic National Forest. These sites are predominantly located in disturbed areas: along road systems, in timber sale units (e.g., Matwat Timber Sale), at the Lake Quinault summer residences, in administrative sites (e.g., Dennie Ahl seed orchard, Snider Work Center, Quinault Ranger Station), in high public use areas (parking areas, viewpoints), in managed areas such as plantations, and in areas utilized for recreation such as campgrounds, dispersed recreation, etc. (Quinault Loop Trail, OHV Slab camp quarry, Seal Rock Campground, etc,).

Places where ecosystem functioning and native plant communities are of high value are also affected; these include meadow systems (e.g., Mint Meadow, Mount Schmidt Knob, Skokomish Savannah Restoration Site, Matheny Prairie); sphagnum bogs (e.g., Cranberry Bog); Research Natural Areas (e.g., Wet Weather Creek and Quinault); and/or wilderness areas (Buckhorn, Colonel Bob, the Brothers Wilderness). Plant community functioning has been disrupted and native vegetation has been replaced by invasive plants in some areas. Without treatment, these weed sites will further displace native plant communities, and continue to spread. Invasive plants have been estimated to spread at a rate of 8 to12 percent each year. Prevention practices may reduce that number by half (2005 R6 FEIS Chapter 4.2, page 4-24).

Roads are conduits for the spread of invasive plants, providing for their transport and dispersal (e.g., seeds and vegetative reproductive parts attached to vehicles) and providing disturbed ground for easy colonization and establishment. Olympic National Forest System roads also serve to introduce invasive species onto the Olympic National Park, where native plant communities and ecological integrity are highly valued, as well as to the Quinault Indian Nation land, where they are aggressively treating Japanese knotweed and gorse to protect riparian areas.

Roads serve to introduce and establish invasives in areas where they were previously unknown. For example, currently gorse is unknown on the Olympic National Forest, although it is a species on their watch list. Gorse is moving in from the Quinault Indian Nation on Highway 101, which goes to Olympic National Forest system lands. This EIS would allow for treatment of these sites.

Timber harvest, livestock grazing, road building, and other ground-disturbing activities occur on National Forest System lands, and contribute to the spread of invasive plants as the habitat conditions that facilitate colonization are created. Early detection of populations of invasive species is critical before they become larger and spread. As population size increases, difficulty and cost of treatment also increase, to the point where eradication may be impossible.

The Olympic National Forest lies within approximately 632,300 acres in the northwest corner of Washington, and surrounds the Olympic National Park. The vegetation of the Olympic Peninsula is strongly influenced by a maritime climate, as it is surrounded by saltwater on three sides: the Pacific Ocean on the west, the Strait of Juan de Fuca on the north, and the Hood Canal on the east. It has distinct eastside and westside ecology, due to the Olympic Mountains in the center.

The southern part of the westside is known for its high rainfall and temperate rainforest, with Sitka spruce, western red cedar, western hemlock, and Douglas-fir. The northern section of the eastside is the driest part of the forest, with a small area of climax Douglas-fir, given the rain shadow effect from the mountains. Glacial and climactic history influenced the evolution of the Olympic flora. As the alpine and continental glaciers advanced, the Peninsula was isolated from other areas. Glacial refugia existed in localized areas where plant species and plant communities survived, resulting in pockets of distinct plant communities. Table 31 displays target species that may be associated with wetter habitats.[24]

[24] Most of these species have been detected along roadsides and other disturbed areas that may be outside of mapped Riparian Reserves.

Table 31-Target Species in Wetter Habitats

Target Species	Potential Wet Habitat
Knotweed	Adjacent to and standing in water (streams, rivers, ponds etc.) and along moist roadside ditches.
Hawkweeds	Moist meadows.
Tansies	On streambanks.
Scotch Broom	Adjacent to and in meadows, streams, and riparian margins.
English Ivy	Can grow over rocks and adjacent to water, but not in water.
Reed Canarygrass	Wetland emergent species, likes to be flooded – in wet ground, streams, marshes, canals, irrigation ditches, etc.
Canada and Bull Thistle	In meadows and along creeks, streams, and in aspen stands adjacent to creeks.
Herb Robert	Adjacent to water, creek, streambanks.
Purple Loosestrife	Streambanks, canals, ditches, and in shallow ponds.
Blackberry	Often a monoculture along streams and rivers, etc.
Oxeye Daisy	Adjacent to and in meadows, and stream, and river edges.
Yellow Nutsedge	Moist or wet areas.

Invasive Plants and Native Plant Species of Local Interest

Botanical Species of Local Interest (SOLI) within 100 feet of treatment areas are displayed in table 32.[25] Botanical SOLI include:

- Regional Forester Sensitive or Proposed Sensitive Species (Forest Service Manual 2670); and
- Survey and Manage Mitigation Measure Species.[26]

No botanical species listed under the Endangered Species Act grow within 100 feet of any treatment area. Invasive plants currently or may someday threaten 20 different botanical SOLI at 90 sites (3 species of fungi, 9 species of lichens and bryophytes, and 8 vascular plant species). Three botanical SOLI at 13 sites are seriously threatened by encroachment of invasive plants.

[25] Databases and records from the Olympic National Forest, Washington State Natural Heritage Program, Oregon Natural Heritage Program, and ISMS (Interagency Species Management System) database were used to overlay SOLI with the invasive plant inventory. Local botanists/ecologists Joan Ziegltrum, Deborah McConnell, and Pat Grover assisted in determining proximity of target species to SOLI. All of the botanical SOLI within 100 feet of treatment areas are Regional Forester Sensitive Species except *E. quinaul*tense, which is proposed to be added to the sensitive list.
[26] "Survey and Manage" is a mitigation measure in the Northwest Forest Plan adopted as part of the Olympic National Forest Plan.

Table 32-Botanical Species of Local Interest, Olympic National Forest

Botanical Species	Type of Species/ Habitat	Number of SOLI sites near invasive plant treatment areas	Level of Threat from Invasive Plants
Lichens and Bryophytes			
Diplophyllum plicatum Survey and Manage Species	Liverwort	1 (of 11 populations recorded in the Pacific Northwest, ISMS database)	No direct threats from invasives have been observed; future (within ten years) threats include loss of/competition for habitat.
Hypogymnia duplicata Survey and Manage Species	Lichen, epiphytic on mountain hemlock, western hemlock, Pacific silver fir, Douglas-fir and subalpine fir in old-growth forests	11 (of 153 populations recorded in the Pacific Northwest, ISMS database)	No direct threats from invasives have been observed; future threats include loss of/competition for habitat if fewer host trees are recruited.
Iwatsukiella leucotricha Sensitive and Survey and Manage Species	Moss; wet areas along the coastal region, on bark of conifers and alders on ridges with fog penetration	5 (of 11 populations recorded In Washington)	No direct threats from invasives have been observed; future threats include loss of/competition for habitat, especially if fewer host trees (silver fir) are recruited.
Nephroma bellum Sensitive and Survey and Manage Species	Lichen; in moist forest with strong coastal influence; often on riparian hardwoods	2 (of 22 populations recorded in Washington)	No direct threats from invasives have been observed; future threats include loss of/competition for habitat if fewer host trees are recruited.
Platismatia lacunosa Sensitive and Survey and Manage Species	Lichen; on boles and branches of hardwoods and conifers and alders in moist riparian forests and cool upland sites	7 (of 18 populations recorded in Washington)	No direct threats from invasives have been observed; future threats include loss of/competition for habitat if fewer host trees are recruited.
Pseudocyphellaria rainierensis Sensitive and Survey and Manage Species	Epiphytic lichen; moist old growth forest	4 (of 56 populations recorded in Washington)	No direct threats from invasives have been observed; future threats include loss of/competition for habitat if fewer host trees are recruited.
Racomitrium aquaticum Survey and Manage Species	Moss, forms mats on shaded, moist rocks and cliffs along shady streams or in forests, often in splash zones, but never in aquatic habitat	3 (of 23 populations recorded in the Pacific Northwest, ISMS database)	No direct threats from invasives have been observed; future (within ten years) threats include loss of/competition for habitat.
Schistostega pennata Sensitive and Survey and Manage Species	Moss; in dark places: upturned rootwads, rock crevices, adjacent to standing water	3 (of 50 populations recorded in Washington)	No direct threats have been observed, and future threats are not expected. This species has a highly selective habitat, one whose niche would not easily be occupied by invasive species.

Botanical Species	Type of Species/ Habitat	Number of SOLI sites near invasive plant treatment areas	Level of Threat from Invasive Plants
Tetraphis geniculata Sensitive and Survey and Manage Species	Moss; old growth downed stumps and large logs in moist areas	20 (of 40 populations recorded in Washington)	No direct threats have been observed, and future threats are not expected. This species has a highly selective habitat, one whose niche would not easily be occupied by invasive species.
Fungi			
Albatrellus avellaneus Survey and Manage Species	Terrestrial, mycorrhizal polypore restricted to Sitka Spruce	3 (of 6 populations recorded in the Pacific Northwest, ISMS database)	No direct threats from invasives have been observed; future (within ten years) threats include loss of/competition for habitat.
Bondarzewia mesenterica Survey and Manage Species	A terrestrial, parasitic polypore found solitary or in clumps, associated with conifers	2 (of 20 populations recorded in the Pacific Northwest	No direct threats from invasives have been observed; future (within ten years) threats include loss of/competition for habitat.
Ramaria lorithamnus Survey and Manage Species	Terrestrial, mycorrhizal fungus associated with late successional Douglas fir and western Hemlock forests in the Pacific Northwest	1 (of 1 population recorded in the Pacific Northwest	No direct threats from invasives have been observed; future (within ten years) threats include loss of/competition for habitat.
Vascular Plants			
Carex anthoxanthea Sensitive Species	Sedge; Grassy, boggy places	1 (of 1 site recorded in Washington State)	Reed canary grass grows in the vicinity. Within five years, reed canary grass may be directly competing with this Carex population.
Carex obtusata Sensitive Species	Sedge; Dry, open ridges, scree meadows, talus slopes, often in late snowmelt pockets from 5800' to 6800'	3 (of approximately 10 sites recorded in Washington)	Invasive plant surveys are not complete at these locations. It is unlikely Canada thistle and common dandelion are competing with Carex obtusata, as rocky, scree ridgeline is not conducive habitat for these invasives.
Carex pauciflora Sensitive Species	Sedge; Sphagnum bogs to 3000'	1 (of approximately 20 recorded sites in Washington)	No direct threat to Carex pauciflora, but within 5 years Canada thistle or herb Robert may out-compete the Carex for space and resources.
Erythronium quinaultense Proposed Sensitive Species	Herbaceous; In openings and rock ledges in coniferous forests at an elevation of 1640 to 2953 ft. (500 to 900 m). Populations have been found from 960-2600 ft.	9 (of 12 populations recorded on the Olympic peninsula, on the Olympic National Forest)	There are 8 sites where invasives are impacting Erythronium quinaultense habitat, competing for space and resources.

Botanical Species	Type of Species/ Habitat	Number of SOLI sites near invasive plant treatment areas	Level of Threat from Invasive Plants
Galium kamtschaticum Sensitive and Survey and Manage Species	Herbaceous; Northerly aspects from 1930' to 2900', in the silver fir or mountain hemlock plant associations, in wet canopy gaps.	2 (8 sites on the Olympic peninsula all of which are on the Olympic National Forest)	No direct threats from invasives. Within 5 years, there is potential for competition for space and resources between invasives and Galium kamtschaticum.
Parnassia palustris var. neogaea Sensitive Species	Herbaceous; Wet meadows, wet rock faces, seeps and along streams and pond edges	5 (19 sites recorded on the Olympic National Forest)	At 4 sites, invasives are impacting Parnassia palustris var. neogaea habitat. Currently, there are no direct impacts to individuals, but within five years there is potential.
Pellaea breweri Sensitive Species	Fern; Rocky crevices, rock outcrops, ledges and talus slopes	1 (of 10 sites recorded in Washington)	Surveys are not complete. It is unlikely invasive species are competing with Pellaea breweri, as rocky, scree ridgeline is not conducive habitat for invasives in this treatment area.
Synthyris pinnatifida var. lanuginosa Sensitive Species	Herbaceous; On scree and talus slopes and other rocky areas in the alpine zone	6 (of less than 20 sites known from the Olympic Peninsula)	There is 1 site where invasives are impacting Synthyris pinnatifida var. lanuginosa habitat. Within five years, there is potential impact to individuals.

3.2.2 Treatment Effectiveness

Treatment effectiveness increases with the number of treatment options available and percentage of the infested land base that may be treated using herbicides. All alternatives, including No Action, approve a wide range of non-herbicide methods, including biological, manual and mechanical treatments. The variation between alternatives is mostly related to the use of herbicides. For the purposes of this analysis, all herbicide application methods (broadcast, hand, spot) are considered equally effective.27 Funding constraints and conditions on neighboring lands may also influence treatment effectiveness; these variables are constant across alternatives.

Invasive plant spread is not continuous or even across the landscape. Invasive plants can "jump" across far distances. For example, a vehicle carrying seeds or propagules, can deposit these "hitchhikers" to another county where that invasive might be otherwise unknown. Hikers are likely to deposit invasive plant seeds along the trail into dispersed recreation sites within the wilderness. The hazard related to invasion of uninfested areas and high value areas like wilderness may be much greater than the hazard related to invasive plant spread elsewhere.

Several of the infested sites on the Olympic National Forest also threaten plant species of local interest. Another indicator of effectiveness is the number of SOLI species that are at risk of extirpation if invasive plants are not effectively treated.

[27]Herbicide application methods may influence cost-effectiveness, for instance, spot and hand treatments tend to cost more per acre than broadcast treatments. This is discussed further in the economic analysis in Chapter 3.7.

Effectiveness of Common Control Measures

Biological Agents

Several biological agents have been approved for release on the Olympic National Forest (Jennifer Andreas, e-mail communication, January 2006). The analyses for effects of such tools have already been completed under documents developed by Agricultural Plant Health and Insect Service (APHIS) for approval of entry of such organisms.

Biological control is self-perpetuating, selective, energy self-sufficient, economical, and well suited to integration in an overall invasive plant management program. Introducing predators, parasites, or pathogens from a plants country of origin does not eradicate, but controls any given invasive plant (R6 2005 FEIS, 2-35 to 2-37).

Biological controls have varied results (Cecile Shohet, personal observations, December 2005). Tansy ragwort (Senecio jacobaea), St. John's wort (Hypericum perforatum), Canada thistle (Circium arvense), and bull thistle (Circium vulgare) have been contained using biocontrols in the western United States (Andrea Ruchty, personal communication, 2006).

The time frame for controlling invasives using biocontrols is very long, and would occur regardless of alternative. The effects of biological agents are described in Appendix J of the R6 2005 FEIS, which states that biological controls:

> "Are unlikely to result in adverse effects to aquatic species (page J-24),
> Have no direct effects on wildlife (page J-19),
> There are few examples of non-target effects (page J-16)."

Manual and Mechanical Treatments

Manual and mechanical treatment methods are approved in all alternatives. These treatments are preferred where effective (consistent with treatment strategies), particularly where impacts (disturbance, compaction) from use of motorized equipment can be minimized. The effectiveness of manual and mechanical treatments increases if herbicides are also available for use. However, if herbicide use is not allowed, stand alone manual and mechanical treatments are less effective, and may actually increase rather than decrease population numbers.

For instance, manual and mechanical treatments can increase populations of meadow knapweed, Canada thistle and Japanese knotweed as pieces of rhizome/root/stem break off and develop into a plant the following spring. Also, in the process of digging/pulling, the disturbance created by the treatment creates the ideal habitat conditions for invasive seeds to germinate and flourish. For these species, in order for manual/mechanical to be effective, meticulous follow-up is necessary several times in a growing season for at least five years, to prevent seeds from being produced and dispersed, and to kill any germinants. In contrast, annuals may be effectively pulled out of the ground by hand (manual treatment) because of their one-year life cycle.

Herbicide Treatments

Greater numbers of herbicide options tend to result in greater potential effectiveness; lower numbers of options tend to result in lower potential effectiveness (R6 2005 FEIS, 4-15 to 4-16, and 4-36). Each invasive species has its own physiology, and its own habitat requirements. Herbicide effectiveness varies substantially depending on the invasive species, treatment timing, restoration plans, and environmental factors. Chapter 2 includes a chart showing the measures considered most effective for the invasive species known on the Olympic National Forest.

A range of herbicide and non-herbicide options is necessary to effectively treat invasive plants (R6 FEIS 4-15). For instance, the herbicide glyphosate does not work effectively for all species of invasives. Glyphosate can be used against woody vegetation, but other herbicides such as triclopyr are more effective (Robin Dobson, personal communication, November 2006). Glyphosate also has more restrictions for effective use; for instance, glyphosate must be applied in the fall after the berries have dropped to effectively treat blackberry, whereas triclopyr is effective applied at any time of year (ibid.).

In addition, nationwide a number of invasives have been found to develop a tolerance to glyphosate, and its effectiveness has been markedly reduced. Dr. Tim Miller, the Washington State Extension Weed Scientist in Mt. Vernon, Washington, reports tolerance to glyphosate in locations close to the Olympic National Forest.

The percentage of the land-base that would be treated varies between alternatives. The more acres left untreated, the greater the likelihood that invasives will spread and compete with native plant communities. Over time, infestations that are left untreated will continue to spread. Thus, another indicator of effectiveness is the acreage of invasive plant infestations projected five years from now.

Effectiveness of Alternative A - No Action

Under Alternative A, the No Action Alternative, some treatments that have been approved under previous NEPA decisions would continue. Invasive plant prevention standards were adopted (R6 2005 ROD) that are expected to reduce the rate of spread of invasive plants across the Pacific Northwest Region from 8 to 12 percent down to 4 to 6 percent. In addition, biological releases (see above) have been approved and would continue to be partially effective under No Action.

On the Olympic National Forest, treatments have been approved for 672 acres. Of these, 86 acres are prescribed for herbicide use (about 2.2 percent of the 3,830 acres estimated to be currently infested). Herbicide use is restricted to spot and/or hand applications of glyphosate, dicamba, and picloram, and in proximity to water, only the herbicide glyphosate can be used. The effectiveness of the No Action Alternative is assumed to be 25 percent, (each year of treatment under Alternative A would reduce population size by 25 percent). This percentage is lower than other alternatives because the comparative acreage allowed for herbicide use is low, and the herbicide selection is limited.

Given estimates of target species average rate of spread and the effectiveness predicted for the most ambitious treatment scenario analyzed for No Action, net infestation would be reduced by about 327 acres by the year 2012. This estimate assumes a $200,000 per year budget and use of the tools currently available under No Action. No Action has a low effectiveness because of the limited use of herbicide. Fewer than half the acreage currently considered high priority would effectively be treated under the most ambitious conceivable No Action treatment scenario. No Action is unlikely to effectively treat invasive plants because so little of the current infestations would be treated.

The rate of invasive plant spread would be reduced via the implementation of prevention practices. The R6 2005 FEIS estimated that invasive plant spread would be reduced from about 10 percent per year to 5, assuming the consistent application of prevention practices. Each year, untreated invasive plants are assumed to spread by this rate.

Invasive plant treatments that occur on parcels neighboring the National Forest System lands would contribute to project effectiveness. Invasive plants flow between land ownerships and administrative units. Treatments must occur across land ownerships to optimize the effectiveness of this alternative.

Table 33-Estimated Invasive Plant Acres, No Action 2007-2012

Year	Acres Invaded	Acres Treated	25% Effectiveness	Acres Remaining	5% Spread
2007	3,830	672	168	3,662	3,700
2008	3,700	504	126	3,574	3,612
2009	3,612	378	94.5	3,518	3,554
2010	3,554	284	71	3,483	3,520
2011	3,520	213	53.25	3,467	3,503
2012	3,503	Last Year of Projection			

Table 34-Summary of Effectiveness Indicators, No Action

	Percentage of Invasive Plants Treated With Herbicide	Number of Herbicide Options	Acres of Invasive Plants 2012
Alternative A (No Action)	2	3	3,503

Under No Action, the values at risk from invasive plants would continue to be great. Three Species of Local Interest would continue to be threatened by invasive plants. Infestations would continue to impact Wilderness Area, Botanical Area and Research National Area values. Meadow and riparian habitats would continue to be at risk. Roads would continue to act as vectors of invasive plant spread between National Forest and other lands.

Effectiveness of Alternative B – Proposed Action and Alternative D

Alternatives B and D respond similarly to this issue, thus they are discussed together in this section. Alternative D has the potential to be more cost-effective than the Proposed Action (see Economic Efficiency Analysis) but assuming unlimited funding, both alternatives allow a sufficient range of options to be used in most, if not all, situations.

Under both of these alternatives, all currently infested acres would be treated with integrated prescriptions that combine manual and mechanical invasive plant control methods with the use of herbicides. Each year of treatment is assumed to reduce population size by 80 percent, given the range of tools that would be available.

The following beneficial effects would be expected from treatment:

- Invasive plant establishment and spread would be reduced along roads, trails and other disturbed areas.
- Native plant communities and ecosystem functions would recover in meadows and forested areas.
- Many invasive populations would never gain a foothold to wilderness, Botanical Special Interest Areas, or Research Natural Areas.
- Recreation and administrative sites would become less of a vector for invasive spread
- Invasive plants would no longer pose threats to invasive plant species of local concern.

Assuming current funding estimates, the highest priority invasives (about one-fifth of the current infestations) could be fully eradicated or controlled by 2012. The rate of invasive plant spread would be reduced via the implementation of prevention practices, however containing or controlling remaining infested sites would take at least 30 years, based on the assumption that each year of treatment, about 80 percent of invasive plant infested acreage would be controlled if the tools included in these alternatives were available.

Table 35-Estimated Invasive Plant Acres, Alternatives B and D, 2007-2012

Year	Acres Invaded	Acres Treated	80% Effectiveness	Acres Remaining	5% Spread
2007	3,830	3,830	3064	766	774
2008	774	765	612	162	164
2009	164	148	118.4	46	46
2010	73	29	23.2	50	50
2011	50	0	0	50	51
2012	51	Last Year of Projection			

Table 36-Summary of Effectiveness Indicators, Alternatives B and D

	Percentage of Current Land Base Where Herbicides May Be Used	Number of Herbicide Options	Acres of Invasive Plants 2012
Alternatives B (Proposed Action) and D	100	10	51

Effectiveness of Alternative C

Given an unlimited budget, Alternative C would still not be as effective as Alternatives B and D. It treats fewer acres with herbicide, and infestations that are difficult to eradicate would likely not be effectively treated given Alternative C's restrictions on the use of herbicides. Examples of target species that are difficult to control without herbicides include Japanese and giant knotweed; purple loosestrife; orange hawkweed; and meadow and brownray knapweed. Alternative C would have less potential to effectively treat these species, especially if they are growing along road ditches and near streams where herbicides would not be used.

Alternative C is less effective than other action alternatives because of its limitations on herbicide use; Alternative C is assumed to reduce target populations by about 42 percent per year. In contrast, under No Action, target populations reduced by 25 percent per year and the other action alternatives are assumed to reduce target populations by 80 percent per year.

Waterways would continue to transport invasives downstream, and invasive dominance would increase along lakes, ponds, creeks, etc. Roads would continue to act as corridors, transporting invasive seeds and propagules to new locations. *Parnassia palustris var. neogaea* is a water-loving vascular plant directly threatened by invasive species. Habitat loss to *Parnassiahas* already occurred from invasive plants and continued spread could lead to mortality. Thus, since these areas are off limits to herbicide use under Alternative C, these two SOLI species would be at continued risk from infestations.

While currently undetected sites could be treated under Alternative C, these future treatments would be less effective because herbicide use restrictions would be applied. Restoration objectives would continue to apply to treated sites and would reduce the potential for re-infestation over time.

As with the other alternatives, the rate of invasive plant spread would be reduced via the implementation of prevention practices. Assuming current funding estimates, less than 17 percent of the inventoried sites would be controlled by 2012. Containing or controlling remaining infested sites would take longer than 35 years. Full eradication of any invasive species would be unlikely.

Invasive plant treatments that occur on parcels neighboring the National Forest system lands contribute to project effectiveness. Invasive plants flow between land ownerships and administrative units. Treatments must occur across land ownerships to optimize the effectiveness of this alternative.

Table 37-Estimated Acres of Invasive Plants, Alternative C, 2007-2012

Year	Acres Invaded	Acres Treated	42% Effectiveness	Acres Remaining	5% Spread
2007	3,830	3,410	2728	1,102	1,114
2008	1,114	681	544.8	569	575
2009	575	136	108.8	466	471
2010	471	27	21.6	449	454
2011	454	0	0	454	459
2012	459	Last Year of Projection			

Table 38-Summary of Effectiveness Indicators, Alternative C

	Percentage of Current Land Base Where Herbicides May Be Used	Number of Herbicide Options	Acres of Invasive Plants 2012
Alternative C	30	10	459

Alternative Comparison – Effectiveness Indicators

Table 39-Comparison of Alternatives, Effectiveness Indicators

	Percentage of Current Land Base Where Herbicides May Be Used	Number of Herbicide Options	Annual Effectiveness (Percent of Population Decreased Each Year of Treatment)	Acres of Invasive Plants 2012
Alternative A (No Action)	2	3	25	3,503
Alternative B (Proposed Action)	100	10	80	51
Alternative C	30	10	42	459
Alternative D	100	10	80	51

Effectiveness of Early Detection-Rapid Response

The most ambitious treatment scenario analyzed would effectively treat all known invasive acreage. The adoption of an Early Detection-Rapid Response protocol would allow for quick treatment of newly found invasive populations, thereby not allowing them to further spread, and reducing impacts on botanical resources in the future. Restoration of treated sites would decrease the likelihood for re-infestation. The IDT predicts that if all infestations were effectively treated immediately, within approximately 6 years target populations would be suppressed, contained, controlled, or eradicated to the extent desired, and treated sites would be restored. Sites will likely have to be revisited in a given year to reach the interior of dense invasives such as knotweed, to accommodate invasive plant reproductive cycles that occur through the year, or to ensure treatment of individual plants that may have been skipped during the initial entry.

Invasive plant treatments that occur on parcels neighboring the National Forest System lands contribute to project effectiveness. Invasive plants flow between land ownerships and administrative units. Treatments must occur across land ownerships to optimize the effectiveness of these alternatives. Alternatives B and D allow a range of treatment options sufficient to effectively treat invasive plants that may threaten resources off National Forest system lands.

Invasive plant spread would be reduced in all alternatives via the implementation of prevention practices. The R6 2005 FEIS estimated that invasive plant spread would be reduced from about 10 percent per year to 5, assuming the consistent application of prevention practices. Each year, untreated invasive plants in all alternatives are expected to spread at this rate.

3.2.3 Environmental Consequences of Invasive Plant Treatments on Non-target Plants

Introduction

All invasive plant treatments are designed to kill or slow the growth of target plants, and some damage to non-target plant species is likely in all alternatives, despite careful planning and implementation. The effects of non-herbicide methods, including the manual and mechanical methods in the scope of the action alternatives, are addressed in Appendix J of the R6 2005 FEIS. While some common vegetation may be impacted by manual and mechanical methods, such effects are unlikely to be significant, because an operator would immediately make adjustments if adverse effects were to occur. Most of the concern about adverse effects of treatment are related to herbicide use, partially because of the potential for drift, leaching or runoff to affect non-target vegetation and/or because adverse non-target effects may not be immediately noticeable.

Herbicides have the potential to shift species composition and reduce diversity of native plant communities, as less herbicide-tolerant species are replaced by more herbicide-tolerant species. The type of herbicide and the application method may also affect plant pollinators. A reduction or shift in pollinator species could also lead to changes in plant species composition or diversity (R6 2005 FEIS Chapter 4.27). For example, the repeated use of triclopyr, a broadleaf selective herbicide, might shift the species composition resulting in a reduction of woody vegetation and an increase in the herbaceous and grass component.

Herbicides can move off-site in water, soil, and wind, thereby affecting non-target vegetation. This can result from spray drift (broadcast and spot), runoff, leaching, or through groundwater movement. Herbicides can vary dramatically in their potential for movement. For example, picloram is highly soluble in water, is mobile under both laboratory and field conditions, is resistant to degradation, and has a high potential to leach to groundwater in most soils. Glyphosate strongly binds to soil particles, which prevents it from excessive leaching or from being taken up from the soil by non-target plants. This herbicide has a low potential for leaching into groundwater systems, and degrades quickly (R6 2005 FEIS Chapter 4, 4-29, 4-32).

Translocation of herbicide between rhizomatous same-species individuals, or from plant-fungi, rootlet-mycorrhizal interactions can also result in herbicide movement. The result may include mortality, reduced productivity e.g., physiological, structural, and abnormal growth (R6 2005 FEIS Chapter 4.27). Effects, such as mortality, brown spots, and chlorotic coloration, may not be immediate, and may become apparent months later. Other non-visible effects e.g., physiologic, may never be noticeable (Marrs, R.H., 1989).

The risk of adverse effects is dependent on the type of herbicide used and the application method chosen. Herbicides have different characteristics, degrees of selectivity, and modes of action. Potency of the herbicide and persistence also are a factor, as is duration of the treatment.

For example, glyphosate is a general, non-selective herbicide, which may kill or damage species from all plant families. In contrast, clopyralid has little effect on the mustard family and grasses. Other herbicides are more selective and thus have less potential to adversely affect non-target plants. However, glyphosate, which is generally non-selective, has no adverse effect on horsetail (non-flowering plant) and some species of algae (Cathy Lucero, personal communication, August, 2005).

Picloram is a persistent herbicide that can remain active for several growing seasons post application. Clopyralid mimics auxins, a plant growth hormone and stimulates abnormal growth. Metsulfuron methyl works by inhibiting the activity of an enzyme called acetolactate synthase, an enzyme necessary for plant growth. If a non-vascular species does not use the above mechanisms, the herbicide may not have any impact at any distance (depending on the surfactant used as well). Table 29 in Chapter 3.1 compares herbicide properties, uses and risks.

The risk to non-target vegetation also varies with the herbicide application method. Spot and hand application methods substantially reduce the potential for loss of non-target vegetation because there is little potential for drift. Drift is most associated with broadcast treatments and can be mitigated to some extent by the applicator.

Spray drift is largely a function of droplet particle size. The largest particles, being the heaviest, will fall to the ground quickly upon exiting the sprayer. Medium size particles can be carried beyond the sprayer swath (the fan shape spray under a nozzle), but virtually all of the particles fall within a short distance of the release point. The smallest, and therefore the lightest particles have the potential to travel the farthest. Thus, if the droplet size forced out the nozzle can be limited to larger particle sizes, the potential for herbicide to drift beyond the targeted vegetation can be controlled.

Factors affecting droplet size are nozzle type, orifice size and spray angle, as well as spray pressure, and the physical properties of the spray mixture. Wind speed restrictions also significantly contribute to a reduction in drift (Spray Drift Task Force, 2001). By simply changing the type of nozzle (diameter of pore size) used during broadcast treatments, the drift potential of herbicide can be effectively and significantly decreased as the droplet size forced out the nozzle is increased in size (Dr. Harold Thistle, personal communication, April 2006).

The physics of sprayers dictates that there will always be a small percentage of the spray droplets that are small enough to be carried in wind currents to varying distances beyond the point of release. Since these smallest droplets are a minor proportion of the total spray volume, their toxicological significance beyond the project area boundary rapidly declines as they are diluted in increasing volumes of air. Vegetation on the ground, including the target invasive species themselves, act as a substantial barrier to herbicide droplet drift as well.

Marrs, R.H., in the 1989 publication, “Assessment of the Effects of Herbicide Spray Drift on a Range of Plant Species of Conservation Interest,” examined the distances drift affected non-target vascular plants using broadcast treatment methods similar to those considered in this EIS. Their observations are consistent with drift-deposition models in which the fallout of herbicide droplets has been measured. The maximum safe distance at which no lethal effects were found was 20 feet, but for most herbicides the distance was 7 feet. Generally, damage symptoms were found at greater distances than lethal effects, but in most cases there was rapid recovery by the end of the growing season. No effects were seen to vascular non-target vegetation further than 66 feet from the broadcast treatment zone. Little information is available for how drift distances may effect non-vascular non-target vegetation. The distance spray drift will travel can vary substantially based on wind speed, topography, temperature, the herbicide applied, and the vegetation present.

Commercial drift reduction agents are available that are designed to reduce drift beyond the capabilities of the determinants previously described. These products create larger and more cohesive droplets that are less apt to break into smaller particles as they fall through the air. They reduce the percentage of smaller, lighter particles that are the size most apt to drift

The Common Control Measures (see Chapter 2.5 and Appendix B for details) include information about effective herbicides and those to avoid in situations near susceptible non-target vegetation. A100-foot broadcast buffer is likely to prevent glyphosate from harming plant species further away (Personal Communications with Dr. Harold Thistle, 2005).

Special Forest Products

The most popular forest products gathered on the Olympic National Forest are berries, beargrass, salal, mushrooms and medicinal plants. Two of these species are target invasive plants (e.g. St. John's wort, Himalayan blackberries). The Olympic National Forest is currently authorized to use herbicide treatments on 86 acres with no adverse effects on special forest products noted. Non-target special forest products would be protected by the Project Design Features in all action alternatives, and increases in herbicide use conceivable in all alternatives would not likely result in adverse effects to non-target special forest products. However, forest products such as berries that are also invasive species would be killed under the most ambitious treatment scenarios.

Effects from Herbicides to Botanical SOLI by Alternative

Direct and Indirect Effects of No Action

Under No Action, spot and hand herbicide treatment is approved on about 86 acres and manual/mechanical treatment on an additional 586 acres. Treatments under the No Action alternative have very low potential to adversely impact fungi and vascular and non-vascular plant species of local interest because:

- The total acreage where herbicide could be used is very low; few treatment acres would occur in any one watershed or area of botanical concern.
- Drift associated with spot application methods is relatively easy to manage and hand application methods do not result in any potential drift.

Under No Action, herbicide use is limited to three herbicides, picloram, dicamba, and glyphosate. This limits the range of herbicides available compared to the action alternatives. Picloram poses specific risks to non-target vegetation because it can be persistent in the soil for several years, is highly soluble in water, is resistant to degradation processes, has a high potential to leach to groundwater in most soils, and is mobile under both laboratory and field conditions. Picloram can also move readily to non-target native plants through root translocation or runoff (R6 2005 FEIS 4-29). Like picloram, dicamba is a selective herbicide that can affect broadleaf and woody species, but in general does not affect grasses (may affect some annual grasses). Runoff from dicamba is one of its greatest risks to non-target vegetation, but the effects are highly site specific, and therefore difficult to quantify. Vaporized or volatilized dicamba can affect non-target vegetation, but the level of effect is not understood, and requires more study (R6 2005 FEIS).

Table 40-Effects to Non-target Vegetation from No Action

Alternative	Number of Possible Broadcast Acres	Number of SOLI Species at Direct Risk from Treatment		
		Fungi	Bryophytes (Moss)	Vascular Plants
No Action	0	0	0	0

Direct and Indirect Effects of Alternatives B (Proposed Action) and D

Alternatives B and D allow use of several new herbicides (chlorsulfuron, metsulfuron methyl, sulfometuron methyl, imazapic, and imazapyr) that are associated with hazards to non-target vegetation (R6 2005 FEIS, 4-27 to 4-33). The range of herbicides available partially mitigates the risk to non-target vegetation by allowing several options; all infestations known within treatment areas may be effectively treated with low risk to non-target vegetation given careful implementation of Common Control Measures and PDFs.

Broadcast applications pose the greatest potential for harm to non-target vegetation due to drift. Under the most ambitious treatment scenario analyzed, Alternative B is estimated to use broadcast application methods about 34 percent of the time (1,320 acres); Alternative D is estimated to use broadcast application methods about 86 percent (3,110 acres) of the time.

Project Design Features listed in Chapter 2 would adequately protect non-target vegetation, including fungi, vascular and non-vascular plant SOLI. Table 16 (Chapter 2.5) displays Protection Widths for Botanical SOLI that would apply to all action alternatives. No direct impacts to sensitive species are predicted at this time; however, the potential for future conflicts results in a determination that Alternatives B and D May Impact Sensitive Plant species. Alternatives B and D would not affect the viability of, and is not likely to lead to, the federal listing of any sensitive botanical species.

Fungi Species of Local Interest

In general, herbicides are not expected to affect the fruiting bodies of fungi (David Pilz, personal communication, Oregon State University, 2005). Fungi can absorb toxic minerals and other toxic compounds, accumulating the herbicide. Fungal SOLI are either parasitic or mycorrhizal, both with an extensive underground hyphal network that potentially can translocate substances (herbicides) to the fruiting body. The effect of individual herbicides to these hyphal networks is largely unknown; therefore, effects to present and future populations of fungi are unknown as well. A long term monitoring study would be required to determine effects because population variability in fungi is common from year to year. Results of studies of herbicide effects to mycorrhizae are varied, running the gamut of effect: stimulation of mycorrhizal growth, no effect, and inhibition (Estok, D. et al, 1989; Busse, M.D. et. al, 2001). This variability is due to differences in the type of herbicide, the concentration utilized, the fungal species, and environmental factors.

In addition, fungi hyphal networks can extend for long distances, and it is uncertain how to adequately buffer for these organisms. Broadcast treatments of herbicide might effect hyphae several hundred feet or more from the SOLI site, or not have any effect at all. The duration of the effect is also unclear, and would be variable depending on the type and concentration of the herbicide utilized, as well as on environmental factors (microbial activity, organic content, soil type, etc.). While the impact herbicides may have on underground hyphal networks is uncertain, monitoring of known fungi sites of interest would identify observable impacts.

Studies have pointed to both beneficial and inhibitory effects due to variation in the type of herbicide, the concentration, the species of fungi and environmental factors. However, adverse effect on the three fungal SOLI, *Albatrellus avellaneus, Bondarzewia mesenterica,* and *Ramaria lorithamnus*, are unlikely as currently there are no locations where broadcast treatments would be within 100 feet of the above ground portion (fruiting body) of these fungi. Effects to fungi would be difficult to ascertain visually, so while monitoring is recommended to note changes in fungi populations after treatment, such monitoring may not be conclusive.

Lichen and Bryophyte Species of Local Interest

Bryophyte and lichens are potentially more prone to injury from broadcast drift than other species due to their unique physiology. They lack a tissue layer (cuticle) that regulates substances entering cells from the air and atmosphere (the cuticle in vascular plants is analogous to human skin). Newmaster et al. (1999) raised concern that drift from glyphosate could affect the long-term sustainability of populations of lichens and bryophytes.

Project Design Features are expected to eliminate impacts to lichens and bryophytes from spot and hand application of herbicide. These measures are also expected to eliminate impacts from drift associated with broadcast application, although there is some uncertainty. Adverse effects (mortality, browning, chlorotic coloration, etc.) would likely be visible immediately to several months after treatment. Invisible physiologic effects are also possible, including reduced reproductive capacity, where seed-set is reduced or the organism becomes infertile.

The 100-foot buffer Project Design Feature for broadcast treatment is based on a study done under similar conditions but for vascular plant species (Marrs et. al., 1989). This buffer incorporates an additional 35 feet to mitigate for the uncertainty about effects on non-vascular species. Monitoring and adaptive management (see Chapter 2.5) would ensure that buffer widths are appropriate.

Vascular Plant Species of Local Interest

Botanical design features were developed to minimize/eliminate effects to vascular plant species from hand, spot, and broadcast application of herbicides and are based on scientific literature and resource management experience. Proximity between invasives and SOLI species is one factor that determines the potential for effect from herbicide application. Translocation may occur between roots of adjacent plants, even with hand application of herbicide.

The robustness or size of the SOLI also plays a role. The likelihood is greater that small, delicate plants may be impacted when adjacent invasives are treated.

Sufficient distance exists between invasive species and botanical SOLI to avoid significant risks, even when considering the five rhizomatous botanical SOLI: *Carex anthoxanthea, Carex obtusata, Carex pauciflora, Galium kamtschaticum*, and *Pellea breweri.*

Table 41-Effects on Botanical SOLI from Treatments in Alternatives B and D

Alternatives	Estimated Proportion of Project Area Where Broadcast Would be Allowed	Number of SOLI Species at Direct Risk from Treatment		
		Fungi	Bryophytes (Moss)	Vascular Plants
Proposed Action (Alternative B)	34%	0	0	0
Alternative D	84%	0	0	0

Direct and Indirect Effects of Alternative C

Alternative C also allows use of several new herbicides (chlorsulfuron, metsulfuron methyl, sulfometuron methyl, imazapic, and imazapyr) that are associated with hazards to non-target vegetation (R6 2005 FEIS, 4-27 to 4-33). Under Alternative C, there would be no broadcast application of herbicide anywhere on the Olympic National Forest so the likelihood of extensive non-target impacts is very low.   No direct impacts to sensitive species are predicted at this time, however, the potential for future conflicts results in a determination that Alternative C May Impact Sensitive Plant species. However, Alternative C would not affect the viability of, and is not likely to lead to, the federal listing of any sensitive botanical species.

Fungi Species of Local Interest

Alternative C eliminates the broadcast treatment option, therefore eliminating most of the potential for effects to fungi. Drift from spot application of herbicide is expected to have no effect to the fungi SOLI, *Phaeocollybia fallax*, because there is sufficient distance to the invasive and drift from spot application is largely controllable by the applicator.

Lichen and Bryophyte Species of Local Interest

Alternative C eliminates the broadcast treatment option, therefore eliminating most of the potential for effects to fungi. Drift from spot application of herbicide is expected to have no effect to the three fungi SOLI, *Albatrellus avellaneus, Bondarzewia mesenterica,* and *Ramaria lorithamnus*, because there is sufficient distance to the invasive plant and drift from spot application is largely controllable by the applicator.

Vascular Plant Species of Local Interest

Botanical PDFs were developed to minimize/eliminate effects to vascular plant species from spot and broadcast application of herbicides. Under Alternative C, there would be no broadcast treatments allowable. Proposed treatments of the following Olympic National Forest vascular SOLI: *Carex anthoxanthea, Carex pauciflora, Erythronium quinaultense, Galium kamtschaticum,* and *Parnassia palustris* var. *Neogaea*, under Alternative C would not result in any further direct, or indirect negative effects from treatment to these species, as they are mainly found in riparian habitats and would not be treated under Alternative C.

Carex obtusata, Pellaea breweri, and *Synthyris pinnatifida* var. *lanuginosa* are not riparian associated and under Alternative C, invasives in proximity to these species could be treated with herbicide. Of the three, none are in close proximity to invasives and spot/hand treatment would have no effect.

Table 42-Alternative C Botanical SOLI at Risk from Treatment

	Estimated Proportion of Project Area Where Broadcast Would be Allowed	Number of SOLI at Risk from Treatment		
		Fungi	Bryophytes (Moss)	Vascular Plants
Alternative C	0	0	0	0

Biological Evaluation

The discussions herein and in Appendix C provide the Biological Evaluation that is required by policy for Regional Forester's Sensitive Species and habitats within the project area. None of the sensitive botanical species are likely to be directly harmed by the project. The PDFs, buffers and monitoring strategy eliminate the likelihood of adverse impacts to species or habitats. No botanical SOLI are near enough to known invasive plant sites to be at risk from treatment.

Under EDRR in all alternatives, an individual SOLI may be damaged or die. Effects on non-vascular plants and fungi are particularly uncertain. Therefore, all alternatives are associated with a finding of "May Impact," for sensitive botanical species.

Pre-project review for potential sensitive non-vascular plants and fungi would occur and any SOLI near a treatment site would be buffered or covered by a barrier. The PDFs, buffers and monitoring strategy ensure that effects to botanical SOLI would be avoided or minimized.

Cumulative Effects of Herbicide Use on Non-target Plants and Fungi

The Affected Environment describes the limited range of some botanical SOLI. While past activities may have contributed to the limited extent of botanical SOLI within the analysis area, the pre-disturbance condition is not known. Therefore, the baseline for comparison of effects to botanical SOLI is the current inventory. None of the alternatives would significantly contribute to population losses of Species of Local Interest compared to the current inventory.

The No Action Alternative does not pose any additional risk to botanical SOLI from treatment above baseline conditions. The 1998 EA/DN found that the currently approved treatments under No Action would have no significant impact on non-target vegetation.

While some adverse effects on non-target vegetation are possible from treatments considered in the action alternatives, they are unlikely to be significant because the extent and threats posed by treatment are generally very small compared to the known range of botanical species, including SOLI. Project Design Features mitigate known risks and the monitoring and adaptive management plan would ensure uncertain risks are also mitigated.

Invasive plant treatments within the range of botanical SOLI may occur on lands outside the National Forest. The amount of treatment and/or specific risks from such treatments is unknown. Project Design Features in all alternatives minimize or eliminate risks to non-target vegetation. No immediate conflicts between treatments and SOLI exist and monitoring and adaptive management would resolve uncertainties over time.

Summary of Effects of Herbicide Use on Non-target Plants and Fungi

Table 43 displays the comparison of alternatives in terms of relative risks associated with herbicide use. Herbicide use in all alternatives would comply with environmental standards, policies and laws. No loss of viability of any botanical SOLI would likely occur.

Table 43-Summary of Effects on Botanical SOLI

Alternative	Estimated Proportion of Project Area Where Broadcast Would be Allowed	Number Of SOLI At Risk from Invasive Plant Treatment (Known Inventory)
A No Action	0	0
B Proposed Action	34%	0
C	0	0
D	84%	0

3.3 Terrestrial Wildlife

3.3.1 Introduction

The potential effect of invasive plant treatment on wildlife is a primary public issue (Issue Group 4). The Olympic National Forest provides diverse habitats, ranging from subalpine forest to wet meadows, and from late successional temperate rainforest of Douglas-fir, hemlock and cedar to mixed conifer plantations, for a diverse array of wildlife species, including amphibians and reptiles. Olympic National Forest System lands are located within the Pacific Flyway, which is a major migratory route for thousands of birds. Many species that are not permanent residents on the Forest may be found here during migration.

Olympic National Forest System lands provide important habitat for three federally listed threatened species and two species that are federal candidates, discussed below. No federally listed endangered species occur on the Forest.

Invasive plant species have become established on Olympic National Forest System lands and continue to spread, causing a loss of wildlife habitat and posing a risk of injury to wildlife. Methods used to control invasive plants have the potential to have adverse effects to individual animals as well as wildlife habitat. The following wildlife analysis focuses on potential effects of treatment on terrestrial Species of Local Interest, including Survey and Management species; Listed and Proposed Threatened and Endangered Species, Regional Forester Sensitive Species and Management Indicator Species (MIS). Effects on MIS species indicate welfare of other species using the same habitat (Thomas 1979). Birds of Conservation Concern are also discussed.

3.3.2 Affected Environment

Invasive Plants and Wildlife Habitat

Some wildlife species utilize invasive plants for food or cover. For example, it has been reported that elk, deer and rodents eat rosettes and seed heads of spotted knapweed. However, the few uses that an invasive plant may provide do not outweigh the adverse impacts to an entire ecosystem (Zavaleta, 2000). More detailed information on the effects of invasive plants to wildlife is reported in the R6 2005 FEIS.

Invasive plants have adversely impacted habitat for native wildlife (Washington Deptartment of Fish and Wildlife, 2003). Any species of wildlife that depends upon native understory vegetation for food, shelter, or breeding, is or can be adversely affected by invasive plants. In the case of common burdock (A*rctium minus),* the prickly burs can trap bats and hummingbirds and cause direct mortality to individuals ((Raloff 1998, National Park Service 1999).

Habitats that become dominated by invasive plants are often not used, or used much less, by native and rare wildlife species.

Washington Department of Fish and Wildlife (2003) identified invasive plants, such as yellow starthistle and knapweed, as threats to upland game bird habitat. Species restricted to very specific habitats, for example pond-dwelling amphibians, are more susceptible to adverse effects of invasive plants.

Of the federally listed species that occur on Olympic National Forest System lands, none are known to be adversely affected by invasive plants within the project area. Bald eagle mortality in other parts of the U.S. has been linked to a toxin produced by a *cyanobacterium* that grows on the invasive aquatic plant, *Hydrilla verticillata* (Wilde, 2005).

Some invasive species could adversely affect bald eagle foraging areas by creating dense patches of tall vegetation in and around streams or rivers that could hinder access to salmon. This speculation is based on observations of some invasive species that grow along rivers and streams in the Region.

In summary, invasive plants are known or suspected of causing the following effects to wildlife:

- Embedded seeds in animal body parts (e.g. foxtails), or entrapment (e.g. common burdock) leading to injury or death
- Scratches leading to infection
- Alteration of habitat structure leading to habitat loss or increased chance of predation
- Change to effective population through nutritional deficiencies or direct physical mortality
- Poisoning due to direct or indirect ingestion of toxic compounds found on or in invasive plants
- Altered food web, perhaps due to altered nutrient cycling
- Source-sink population demography, with more demographic sinks than sources
- Lack of proper forage quantity or nutritional value at critical life periods

Threatened, Endangered, Sensitive, and Management Indicator Species

Federally Listed Species

Several species listed as "threatened" under the Endangered Species Act (ESA) of 1973 (as amended) are found on Olympic National Forest System lands. In addition, the U.S. Fish and Wildlife Service (FWS) maintains a list of "candidate" species. Candidate species are those taxa that the FWS has on file sufficient information on biological vulnerability and threats to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions (U.S. Fish and Wildlife Service 1996). Listed and candidate species of terrestrial wildlife found on Olympic National Forest System lands are included in Table 44.

Table 44-Federally Listed Species on Olympic National Forest

Common Name	Scientific Name	Status	Critical Habitat
Mammals			
Pacific fisher	*Martes pennanti*	Candidate	None
Mazama pocket gopher	*Thomomys mazama melanops*	Candidate	None
Birds			
Northern spotted owl	*Strix occidentalis caurina*	Threatened	Designated
Marbled murrelet	*Brachyramphus marmoratus*	Threatened	Designated

The two candidate species found on Olympic National Forest System lands are also included in the Regional Forester's Sensitive Species List and are discussed in the section titled "Forest Service Sensitive Species."

Brief general descriptions of the species' life history, threats, conservation measures, and their occurrence are in Appendix C. Detailed species accounts prepared for the Biological Assessment prepared for the R6 2005 FEIS are incorporated by reference.

A Biological Assessment prepared for this project and submitted to the Fish and Wildlife Service (FWS) as part of Consultation under the Endangered Species Act is available in the analysis files. The FWS published a Letter of Concurrence April 2007, agreeing with the Forest Service that this project is not likely to adversely affect federally listed terrestrial wildlife.

Forest Service Sensitive Species

Terrestrial wildlife species found on Olympic National Forest system lands that are included in the Region's "Special Status/Sensitive Species Program" are listed in Table 45. The "Special Status/Sensitive Species Program" and the Regional Forester's Sensitive Species List are proactive approaches for meeting the Agencies obligations under the Endangered Species Act and the National Forest Management Act (NFMA), and National Policy direction as stated in the 2670 section of the Forest Service Manual and the U.S. Department of Agriculture Regulation 9500-4. The primary objectives of the Sensitive Species program are to ensure species viability throughout their geographic ranges and to preclude trends toward endangerment that would result in a need for federal listing. Species identified by the FWS as "candidates" for listing under the ESA, and meeting the Forest Service criteria for protection, are included on the Regional Forester's Sensitive Species Lists.

Table 45-Regional Forester Sensitive Terrestrial Wildlife Species

Common Name	Scientific Name	Occurrence on National Forest System Lands*
Mammals		
Townsend's big-eared bat	*Corynorhinus townsendii*	Documented
Pacific fisher	*Martes pennanti*	Extirpated, historically Documented
Mazama pocket gopher	*Thomomys mazama melanops*	Suspected

Common Name	Scientific Name	Occurrence on National Forest System Lands*
Birds		
Bald eagle[28]	*Haliaeetus leucocephalus*	Documented
Common loon	*Gavia immer*	Documented
American peregrine falcon	*Falco peregrinus anatum*	Documented
Amphibians		
VanDyke's salamander	*Plethodon vandykei*	Documented
Cope's giant salamander	*Dicamptodon copei*	Documented
Olympic torrent salamander	*Rhyacotriton olympicus*	Documented
Terrestrial Invertebrates (also Northwest Forest Plan Survey and Manage Species)		
Puget Oregonian	*Cryptomastix devia*	Documented
Burrington's jumping slug	*Hemphillia burringtoni*	Documented
Warty jumping slug+	*Hemphillia glandulosa*	Documented
Malone's jumping slug	*Hemphillia malonei*	Suspected
Blue-gray taildropper	*Prophysaon coeruleum*	Suspected
Hoko vertigo	*Vertigo n. sp.*	Suspected

*Documented/Suspected: Documented means that an organism that has been verified to occur in or reside on an administrative unit. Suspected means that an organism that is thought to occur, or that may have suitable habitat, on Forest Service land or a particular administrative unit, but presence or occupation has not been verified.
+ The warty jumping slug was removed from the Survey and Manage list for Olympic National Forest in the 2001 annual species review.

The Pacific fisher and the California wolverine do not currently occur on Olympic National Forest system lands. The wolverine occurrence is a mistake in the 2004 Regional Forester's Sensitive Animal List which will be corrected in the next version (Piper, 2005, personal communications). The Pacific fisher is extirpated from the entire state of Washington (WDFW, 2005). The Pacific fisher and California wolverine will not be discussed further in this analysis.

Brief general descriptions of the species' life history and their occurrence on the Olympic National Forest are in Appendix C.

Survey and Manage Species

"Survey and Manage" species were identified in the 1994 Northwest Forest Plan. In 2001 (2001 ROD) and again in 2004 (2004 ROD), the agencies sought to make changes in this mitigation measure. The 2004 ROD was litigated and on January 9, 2006, Judge Pechman signed an Order that reinstated the 2001 ROD. Thus, the Survey and Management Mitigation Measure currently applies to all species that were included in the program in 2001. Species that were added to the Regional Forester's Sensitive Species Program in 2004 remain in both programs and are discussed above, with further information in Appendix C.

For the Olympic National Forest, mollusks were the only fauna included in the Survey and Manage program in the 2001 ROD. All Survey and Manage mollusks were added to the Sensitive Species Program, except for evening fieldslug (*Deroceras hesperium*) and are therefore listed above.

Evening fieldslug

This slug has been reported to be associated with wet meadows in forested habitat in a variety of low vegetations, litter, and debris; rocks may also be used (Pillsbury 1944). Little is known about this species or its habitat, but it is thought to be most associated with perennial wetlands, springs, seeps in riparian areas (Duncan et al. 2003). It is one of the least known slugs in the western U.S. (Duncan 2005). Most of the 19 documented sites for this species occur on the eastern slope of the Oregon Cascades (Duncan 2005).

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[28]The bald eagle was removed from the endangered species list (delisted) on June 28, 2007 (U.S. Fish and Wildlife Service 2007). Effects and PDFs would not be affected by the delisting; as per Forest Service policy, it is now included on the Region 6 Regional Forester's Sensitive Species List. No changes to PDFs were made.

No known sites are reported in Washington. From 1998-2002, the Olympic National Forest conducted extensive surveys for this species, as well as other mollusks, across the forest in a range of habitat conditions. Because the evening fieldslug has not been documented on the Olympic National Forest, no effects are conceivable and this species will not be discussed further in this document.

Management Indicator Species

Management Indicator Species (MIS) are selected species whose welfare is believed to be an indicator of the welfare of other species using the same habitat or a species whose condition can be used to assess the impacts of management actions on a particular area (Thomas 1979). Table 46 includes those species that were identified as MIS for the Olympic National Forest (USDA 1990). Aquatic MIS are discussed in the aquatic species specialist's report.

Table 46-Terrestrial Wildlife Management Indicator Species

Common name	Scientific Name
Bald eagle	*Haliaeetus leucocephalus*
Northern Spotted owl	*Strix occidentalis caurina*
Pileated woodpecker	*Dryocopus pileatus*
"Primary cavity excavators"	see below
Columbian black-tailed deer	*Odocoileus hemionus columbianus*
Roosevelt elk	*Cervus canadensis roosevelti*
Pine marten	*Martes americana*

Species identified as MIS for the Olympic National Forest, with the exception of the Roosevelt elk and Columbia black-tailed deer, represent a suite of species that are dependent on mature and old-growth forest habitat. The black-tailed deer and elk represent wildlife associations that require a mix of vegetative age classes.

Pileated woodpecker

The pileated woodpecker represents species that inhabit mature coniferous forest habitats. The pileated woodpecker is the largest woodpecker species in the western United States and nests in cavities of large trees or snags.

It is a denizen of mature forests, relying on dead and decaying trees for foraging and nesting. Pileated woodpeckers can act as a keystone habitat modifier by excavating large numbers of cavities that are depended upon by several other species, and by influencing ecosystem processes such as decay and nutrient cycling (Aubry and Raley 2002). Pileated woodpeckers will return to areas after timber harvesting (Ehrlich 1988), however, past management in the Pacific Northwest has lead to relatively few snags and down logs, especially of large diameters, remaining in many watersheds. Previous timber harvest, as opposed to wildfire events, has had the greatest effect on the availability of large diameter standing dead trees in the Olympic National Forest.

Primary Cavity Excavators

A large number of species rely on cavities in trees for shelter and nesting. The Olympic National Forest has designated a group of species for this Management Indicator category. This group of species represents snag-dependent cavity nesters, and includes animals dependent on dead or dying trees for nest sites. "Primary cavity excavators" comprise a broad group of species associated with standing dead trees or snags and down logs, and that excavate their own nests. Species included in this MIS group are listed in Table 47.

Table 47-Primary Excavator Species

Primary Excavators	Occurrence on Olympic National Forest
Lewis' woodpecker	transient
Red-breasted sapsucker	common

Primary Excavators	Occurrence on Olympic National Forest
red-napped sapsucker	transient
downy woodpecker	very common
hairy woodpecker	very common
three-toed woodpecker	very rare
black-backed woodpecker	transient
northern flicker	very common
pileated woodpecker	common
black-capped chickadee	common
mountain chickadee	very rare
chestnut-backed chickadee	very common
red-breasted nuthatch	very common
white-breasted nuthatch	transient
northern flying squirrel	common

Brief general descriptions of the cavity excavator's life history and their occurrence are in Appendix C

Roosevelt Elk and Columbian Black-tailed Deer

These two species are known throughout the Olympic National Forest and Peninsula. There are several established herds of Roosevelt elk that reside on the Forest as year-round residents, as well as many that are migratory, for example, moving into the Olympic National Park during the summer. Deer occur throughout the forest, and both species use a combination of habitats comprised of cover and forage areas that are not too fragmented by road systems. Taber and Raedeke (1980) reported that winter mortality, legal harvest, and poaching were the primary causes of elk mortality. Poaching is the second leading cause of mortality to elk in Washington State and is prevalent on the Olympic Peninsula (WDFW 2004). As one might expect, a high density of roads, common throughout much of the Peninsula, would have a negative impact on elk with increased disturbance from legal hunting and poaching (CEMG 1999).

On the Olympic Peninsula, winter range is typically defined as land below 1500 feet in elevation (USDA 1995). The Olympic Land and Resource Management Plan (USDA 1990) provides interim direction that in those areas managed for winter survival, habitat should be managed to provide 10-15 percent of the area in openings (natural and created) and the remainder in thermal and hiding cover, 20 percent of which should be optimal cover (the Land and Resource Management Plan also recommends managing roads to reduce wildlife disturbance). Preferred forage areas are in natural openings or managed stands that have been harvested no later than 30 years ago.

Pine Marten

The pine marten (also known as the American marten) represents species that inhabit mature coniferous forest habitats. Pine martens occur in forests containing snags and down logs, which provide suitable denning sites. Pine marten are most closely associated with heavily forested east and north-facing slopes that contain numerous windfalls (Maser 1998). They tend to avoid areas that lack overhead protection and the young are born in nests within hollow trees, stumps, or logs. According to a Washington Department of Fish & Wildlife study (Sheets 1993), which combined trapper interviews with remote camera surveys in various locations on the Peninsula, it was concluded that marten may only be found within the Olympic National Park, and in surrounding low elevation wilderness areas and un-fragmented mature timber on the Olympic National Forest adjacent to the park. National Forest land, in general, has perhaps become too fragmented to support a population.

Historic fire and intensive forest stand management within the national forest has lead to relatively few large snags and down logs, resulting in lower densities relative to historic levels. Much of the area is less than 60 years old and is interspersed with small patches of old growth.

The Olympic National Park has conducted surveys for pine marten in recent years using smoked track plates and remote camera stations. No pine marten have been detected within the park during these surveys. Given these survey results, it is unlikely that they would occur on the Olympic National Forest, but they could be present in more remote wilderness areas, or in contiguous mature forest, where forest has not been fragmented.

Birds of Conservation Concern

Olympic National Forest System lands are included in Bird Conservation Region Five (Northern Pacific Forests). Within this region, Olympic National Forest System lands may provide significant habitat, based on range maps in NatureServe Explorer (NatureServe 2005, Ridgely et al. 2003) and forest survey information) for five species listed by the United States Department of Interior Fish and Wildlife Service (FWS) as "Birds of Conservation Concern.. These species include black swift (*Cypseloides niger*), rufous hummingbird (*Selasphorus rufus*), and olive-sided flycatcher (*Contopus cooperi*). Peregrine falcons *(Falco peregrinus*) are included in Bird Conservation Region Five and occur on the Olympic Peninsula, but they are not known to nest on Olympic National Forest System lands, based on recent surveys. Brief descriptions of these species' life history are found in Appendix C.

Landbirds

In 1999, Partners in Flight released a conservation strategy for landbirds in coniferous forests of western Oregon and Washington (Altman 1999). The strategy identifies a select group of focal species and their associated habitat attributes that can be used to identify desired forest landscapes. All of the focal species identified (Altman 1999, Table 3, p. 20) are found on the Olympic National Forest. The strategy is intended to help facilitate land management planning for healthy populations of native landbirds. The document focuses on landscape-scale forest management, with emphasis on habitat structure. The conservation options recommended in the strategy are not relevant to invasive plant treatments because the treatments proposed in this FEIS do not involve modifying forest habitat structure or any other modifications to native habitat.

Amphibian Decline

Many species of amphibians in many parts of the world have experienced alarming population declines in the past two decades. International task forces have been formed and scientists have researched causes. A number of studies have documented declines, even in relatively undisturbed habitats (Drost and Fellers 1996, Lips 1998), while other studies have found some populations to be stable (Pechmann et al. 1991). However, detecting actual population declines in amphibian populations is difficult due to the extreme annual variation in populations caused by environmental factors, such as drought (Pechmann et al. 1991, Reed and Blaustein 1995).

Potential causes of amphibian declines investigated include ultraviolet radiation (Starnes et al. 2000, Adams et al. 2001), pesticides (Bridges and Semlitsch 2000), global warming (Blaustein et al. 2001, Crump 2005) habitat loss, non-native predators (e.g. Drost and Fellers 1996, Knapp and Matthews 2000), and disease (Muths et al. 2003, Berger et al. 1998, Berger et al. 1999), among others. Results of studies are variable and some populations are in decline while others are not. There is no "smoking gun" and all the causes are implicated to some degree (Halliday 2005).

Hayes et al. (2003, 2006) found that exposure to the herbicide atrazine caused hermaphroditism and testicular oocytes in African clawed frogs and wild leopard frogs and suggested that this could be concern in regard to amphibian declines. Population level effects to amphibians from atrazine exposure are unclear as wild leopard frogs were abundant at collection sites for the Hayes et al. study (2003).

3.3.3 Environmental Consequences

Introduction

Effects of invasive plant treatment methods to wildlife were evaluated and discussed in detail in the R6 2005 FEIS and its Appendix P, the corresponding Biological Assessment (USDA Forest Service 2005c), project files, and SERA risk assessments (2001, 2003, 2004). These documents indicate that disturbance from manual and mechanical treatment pose greater risks to terrestrial wildlife species of local interest than herbicide use. Exposure scenarios used to analyze potential effects from herbicides are discussed in Appendix P of the 2005 R6 FEIS (pp. 15-17). The potential effects to birds from herbicide are listed in Table 4-9 of the R6 2005 FEIS.

A summary of direct and indirect effects to terrestrial wildlife Species of Local Interest follows:

For spotted owls and marbled murrelets, loud and sudden noises above background or ambient levels (those above 92 dB) can cause disturbance that might flush a bird off the nest or abort a feeding attempt. Vehicles used to spray roadside vegetation with herbicides do not make noise above 92 dB, based on recent field measurements, so no "injury" or "harassment" from noise will occur. Other mechanical devises proposed for use on invasive plants include brushing machines, mowers, chainsaws, and string trimmers. These tools have the potential to create noise above background levels that may disturb owls or murrelets if used close to nests during the early nesting season. Bald eagles could be disturbed by these same tools, as well as human presence, but eagles are quite variable in their responses to activity and noise in the vicinity of their nests or roosts.

Small species that lack rapid mobility (e.g. mollusks and salamanders) are vulnerable to crushing or injury from people or equipment. Invasive plant treatments will not alter native habitat structure or composition for MIS, or bird species included in Birds of Conservation Concern or the Partners in Flight strategy for landbirds (Altman 1999).

Risk from herbicide exposure was determined using data and methods outlined in the SERA risk assessments. Tables 8 and 9 in the Biological Assessment for the R6 2005 FEIS (USDA Forest Service 2005c, pp. 138-140) list the toxicity indices used as the thresholds for potential adverse effects to mammals and birds (respectively) from each herbicide. A quantitative estimate of dose using a "worst case" scenario was compared to these toxicity indices. There is insufficient data on species-specific responses to herbicides for free-ranging wildlife, so wildlife species were placed into groups based on taxa type (e.g. bird, mammal), body size, and diet (e.g. insect eaters, fish eaters, herbivores).

Under "worst case" scenarios, mammals and birds that eat insects or grass may be harmed by some herbicides and surfactants. Amphibians also appear to be at higher risk of adverse effects due to their permeable skin and aquatic or semi-aquatic life history.

The SERA and Bakke risk assessments and the R6 2005 FEIS indicated that for typical application rates, triclopyr and NPE surfactants produced doses that exceeded toxicity indices for birds and mammals. NPE surfactant exceeded the toxicity index for direct spray of a small mammal, large mammal and large bird that consumed contaminated vegetation (acute), and small mammal and small bird that consume contaminated insects.

The "worst case" exposure scenarios do not account for factors such as timing and method of application, animal behavior and feeding strategies, seasonal presence or absence within a treatment area, and/or implementation of Project Design Features. Therefore, risk is overestimated when compared to actual applications proposed in this EIS.

Nonetheless, caution in the design and implementation of the project is warranted. In many cases, insufficient data is available to allow quantitative risk assessment. For instance, data was insufficient to assess risk of chronic exposures for a large grass-eating bird from NPE exposure, or insect-eating birds and mammals for several herbicides. Data was also lacking on potential adverse effects of herbicides to mollusks and amphibians.

Some data suggested that amphibians may be as sensitive to herbicides as fish (Berrill et al. 1994; Berrill et al. 1997; Perkins et al. 2000).

The limited spatial extent of infestations, which are limited primarily to disturbed roadsides (see Section 2.5), and the limits placed on herbicide applications will reduce exposure of wildlife to herbicides. Standards 19 and 20 adopted in the R6 2005 ROD require that adverse effects to wildlife species of local interest from invasive plant treatments be minimized or eliminated through project design and implementation. In addition, Standard 16 restricts broadcast use of triclopyr, which eliminates plausible exposure scenarios. All action alternatives must be designed to comply with these standards.

To account for uncertainty, the Project Design Features, for example, eliminate broadcast herbicide treatments near perennial streams; minimize disturbance to certain habitats during certain times of the year; and limit the amount or proportion of certain habitats that may be treated in a 30-day period. These Forest Plan Standards and Project Design Features ensure that no alternative adversely affects federally listed species; results in a trend toward listing of any sensitive species; nor adversely impacts the habitat of Management Indicator Species, landbirds, or Birds of Conservation Concern.

Direct and Indirect Effects on Federally Listed Species: Spotted Owls, Marbled Murrelets

This project is not likely to adversely affect northern spotted owl and marbled murrelet. Marbled murrelets feed upon fish, however their prey is not found on National Forest System land. Even if they fed on contaminated fish for a lifetime, the estimated dose for herbicide or NPE does not exceed a threshold of concern for potential effects (i.e. the toxicity index).

For spotted owls, no herbicide or NPE dose from feeding on prey that had been directly sprayed exceeded the toxicity index for typical application rates. In addition, exposure of spotted owl prey to herbicide, and the consumption of contaminated prey by spotted owls are not plausible because of the life history and habitat of the prey. The owl’s arboreal and nocturnal prey, which does not feed upon invasive plants, has almost no opportunity to become exposed to herbicide or NPE surfactants.

Northern Spotted Owl

Disturbance

Invasive plant treatments may disturb spotted owls during the nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people, vehicles and equipment. The potential for visual disturbance to cause harassment of spotted owls is low. Noise-generating activities above ambient could potentially cause enough disturbance to result in harassment of northern spotted owls during the breeding season. Noise or visual stimuli may interrupt or preclude essential nesting and feeding behaviors, cause flushing from the nest or missed feedings of young (U.S. Fish and Wildlife Service, 2003).

Projects that generate noise or activity above ambient levels and occur within the 35 yards (for heavy equipment), or 65 yards (for chainsaws or motorized tools), from an active spotted owl nest may cause these harassment effects (U.S. Fish and Wildlife Service, 2003). Some equipment used to treat invasive plants could create noise above ambient levels, depending upon site-specific conditions. Engines used to pump herbicide and other liquids through nozzles for roadside spraying operations, normally in the back of a pick up truck, may generate noise levels that could disturb spotted owls. Because noise levels of this type of equipment were not known, two diesel pump engines used for roadside spraying were evaluated for noise level. Two separate readings of different pump engines using different decibel meters produced readings of 72-75 decibels within 10 yards, dropping to 64-67 decibels at 35 yards (observations in the project file). The threshold for noticeable noise is 70 decibels and the threshold for disturbance causing “injury” or “harassment” is 92 decibels (U.S. Fish and Wildlife Service 2003). Vehicles used to spray roadside vegetation with herbicides do not make noise above 92 dB, based on the measurements taken, so no effect to the northern spotted owl from noise disturbance will occur. Within 10 yards of a nest or un-surveyed suitable habitat, roadside spraying could create a brief noise of notice to spotted owls (e.g. slightly above 70 dB), but not loud enough to create disturbance (U.S. Fish and Wildlife Service 2003, project file data). County Weed Coordinators also reported that the noise of diesel pump engines measured for this analysis was greater than the noise of gasoline-powered pump engines used by some operators (D Sherwin personal communication 2005, D. Durfey personal communication 2005). The gasoline-powered pump engines are likely quieter than the diesel pump engines in the study.

On Olympic National Forest System lands, five known spotted owl activity centers are located within 65 yards of treatment areas where brushing or mowing is currently prescribed. There is also an abundance of unsurveyed suitable habitat on the Olympic National Forest where spotted owls could nest. Mowing and brushing uses machinery that can create louder noise, so treatment areas with these methods was considered a potential disturbance effect for owls.

Treatment areas that may use brushing or mowing include 3,442 acres of suitable habitat for spotted owls and/or marbled murrelets. The mandatory PDF for spotted owls (PDF J2) requires that these methods, or others that generate sufficient noise (greater than 92 dB), to be conducted farther away than 35 yards for heavy equipment or motorized hand tools, and 65 yards for chainsaws, or outside the breeding season. This PDF is also included in a Programmatic Biological Opinion for the Olympic National Forest (U.S. Fish and Wildlife Service, 2003) and will minimize effects to spotted owls because it minimizes or eliminates the source of disturbance near nests or suitable habitat.

Therefore, noise from mechanical and manual methods to control invasive plants, including equipment used to spray roadside vegetation, “may affect, but is not likely to adversely affect” spotted owls.

Effects of Herbicides

Exposure scenarios used to analyze potential effects from herbicides are discussed in R6 2005 FEIS, Appendix B, p. 461. None of the herbicides proposed for use in this EIS nor NPE surfactants, applied at typical application rates, pose a risk to northern spotted owls.

Spotted owls are not likely to be directly sprayed, or encounter vegetation that has been directly sprayed, because no aerial applications are proposed. No ground applications of herbicide would reach the upper canopies of mature trees where the owls nest and forage.

Spotted owls within Douglas-fir/Hemlock forests prey on red tree voles and flying squirrels, which are nocturnal and chiefly arboreal. Voles feed on the needles of Douglas-fir trees and the flying squirrels feed primarily on fungi and lichen. Arboreal owls or their prey are unlikely to be exposed to herbicides used within their activity centers in this forest type. However, a worst-case exposure scenario for the spotted owl was conducted using consumption of prey that had been directly sprayed and assuming 100 percent absorption of the herbicide.

The following interpretations of the exposure scenario results are made with the reservation that toxicity data was generated from laboratory animals which may not accurately represent potential effects to free-ranging wildlife.

At typical application rates, the estimated doses from the exposure scenarios are all less than the reported NOAELs (no-observable adverse effect levels) for all herbicides and NPE. Therefore, there is no basis for asserting or predicting that adverse effects to spotted owls from NPE or the herbicides considered in this EIS are plausible.

Critical Habitat

Invasive plant treatments do not remove or modify any of the primary constituent elements that define critical habitat. The action alternatives will have “no effect” to critical habitat for the northern spotted owl.

Marbled Murrelet

Disturbance

Invasive plant treatments are associated with disturbance that may occur during the marbled murrelet nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people, equipment and vehicles. However, the potential for visual disturbance to cause harassment of marbled murrelet is low.

Noise-generating activities above 92 dB could potentially cause enough disturbance to result in harassment during the breeding season (U.S. Fish and Wildlife Service 2003). Vehicles used to spray roadside vegetation with herbicides do not make noise above 92 dB, based on the measurements taken, so no effect to the marbled murrelet from noise disturbance will occur. Within 10 yards of a nest or un-surveyed suitable habitat, roadside spraying could create a brief noise of notice to marbled murrelets (e.g. slightly above 70 dB), but not loud enough to create disturbance resulting in "harassment" or "injury" (U.S. Fish and Wildlife Service 2003, project file data, see spotted owl section above).

Mowing and brushing uses machinery that can create louder noise, so treatment areas with these methods may disturb murrelets. Treatment areas that may use brushing or mowing include 3,442 acres of suitable habitat for spotted owls and/or marbled murrelets.

Mandatory PDFs (J3a and J3b) for marbled murrelets require that these methods, or others that generate sufficient noise, be conducted farther away than 35 yards for heavy equipment or motorized hand tools, and 45 yards for chainsaws, or outside the breeding season. This will minimize any potential disturbance. There are 20 known or historic marbled murrelet sites within 65 yards of treatment areas that are currently prescribed for brushing or mowing. These PDFs have been included in a Programmatic Biological Opinion for the ONF (U.S. Fish and Wildlife Service, 2003) and will minimize effects marbled murrelets because it minimizes or eliminates the source of disturbance near nests or suitable habitat.

Therefore, noise from mechanical and manual methods to control invasive plants, including equipment used to spray roadside vegetation, "may affect, but is not likely to adversely affect" marbled murrelets.

Effects of Herbicide

Exposure scenarios used to analyze potential effects from herbicides are discussed in USDA Forest Service 2005b, Appendix B. None of the herbicides proposed for use in this EIS nor NPE surfactants, applied at typical application rates, pose a risk to marbled murrelets.

Marbled murrelets are not likely to be directly sprayed, or encounter vegetation that has been directly sprayed, because no aerial applications are proposed. No ground applications of herbicide would reach the upper canopies of mature trees where murrelets nest.

Murrelets feed on marine fish, which will not be exposed to herbicides or NPE from control of invasive plants on lands administered by the Forest Service. It is not plausible for their primary prey to be exposed to herbicides or NPE considered in this analysis. However, some murrelets in some locations have been reported to feed upon some freshwater fish (Carter and Sealy 1986). Therefore, in order to investigate a worst-case scenario for exposure, a scenario involving the consumption of contaminated fish was analyzed. The potential for the herbicides included in the action alternatives to adversely affect marbled murrelets was determined using quantitative estimates of exposure from worst-case scenarios. The dose estimates for fish-eating birds were calculated using herbicide or NPE concentrations in fish that have been contaminated by an accidental spill of 200 gallons into a small pond.

Assumptions used include no dissipation of herbicide, bioconcentration is equilibrium with water, contaminant level in whole fish is used, and upper estimate assumes 15 percent of body weight eaten/day. For chronic exposures, we used a scenario where the bird consumes fish from water contaminated by an accidental spill over a lifetime. All estimated doses used in effects analysis were the upper levels reported in the Forest Service/SERA risk assessments.

The following interpretations of the exposure scenario results are made with the reservation that toxicity data was generated from laboratory animals that may not accurately represent potential effects to free-ranging wildlife. The results of the exposure scenarios indicate that no herbicide or NPE surfactant poses any plausible risk to birds from eating contaminated fish. All expected doses to fish-eating birds for all herbicides and NPE are well below any known NOAEL (see R6 2005 ROD, Appendix B). Even if they fed, for a lifetime, upon fresh-water fish that had been contaminated by an accidental spill of herbicide or NPE, they would not receive a dose that exceeds any known NOAEL. Therefore, marbled murrelets would not be adversely affected by herbicide use in any alternative.

Critical Habitat

Invasive plant treatments do not remove or modify any of the primary constituent elements that define critical habitat. The action alternatives will have no effect to critical habitat for the marbled murrelet.

Summary of Effects Determinations – Federally Listed Species

Table 48-Effects Determinations on Federally Listed Species (All Action Alternatives)

Species	Status	Effects Determinations
Northern Spotted Owl	Threatened	May Affect, Not Likely to Adversely Affect
Marbled Murrelet	Threatened	May Affect, Not Likely to Adversely Affect

Direct and Indirect Effects on Regional Forester Sensitive Species

Under all alternatives, two primary effects on sensitive wildlife species are plausible: 1) disturbance and trampling from machinery or people treating invasive plants; and 2) risk from herbicide contact, particularly to species for which data is not sufficient to allow quantitative estimates of risk.

Sensitive species' habitat would be protected in all alternatives because invasive plant treatments do not remove suitable habitat for any species, and the majority of the treatments will occur along highly disturbed roadsides which do not provide suitable habitat in most cases. Some species on the Olympic National Forest may have suitable habitat along roads, although in small amounts relative to the amount of suitable habitat that is not within a road corridor.

Bald Eagle

Disturbance

Potential effects of invasive plant treatment methods on bald eagles are associated with disturbance that may occur during the nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people and vehicles. Human and vehicle presence can disturb bald eagles during the breeding season, causing the birds to leave nests, or stay away from the nest long enough to have detrimental effects to eggs or young (U.S. Fish and Wildlife Service, 1986). Effects from mechanical methods (e.g. tractors, bulldozers, chainsaws, or string trimmers) may be more likely to occur at greater distances from the project site, because machinery creates louder noise.

The critical period in Washington when human activities could disturb occupied nests extends from January 1 to August 15 (U.S. Fish and Wildlife Service, 2003, p.9). Bald eagles are sensitive to human disturbance during this time, particularly within sight distance of nest sites. Invasive plant treatments will avoid conducting projects that create noise or disturbance above ambient levels in proximity to an occupied nest during the nesting season, as required by PDF J1a. This same PDF is included in a Programmatic Biological Opinion for the Olympic

National Forest (U.S. Fish and Wildlife Service, 2003) and will minimize effects to bald eagles because it minimizes or eliminates the source of disturbance near nests.

Invasive plant treatments will not result in the removal of bald eagle nest or roost trees, or suitable habitat, because invasive plants do not provide habitat. Projects could occur within suitable habitat.

Eleven bald eagle nests occur within 0.25 mile of proposed treatment areas. Because disturbance is a plausible occurrence, all action alternatives may affect bald eagle. However, the project design features included in all alternatives would minimize the likelihood that disturbance to nesting eagles would actually occur. Therefore, all alternatives "May Impact Individuals, but Would Not Likely Lead to a Trend toward Federal Listing."

Wintering bald eagles on the Olympic National Forest can be sensitive to disturbance from October 31 to March 31 (U.S. Fish and Wildlife Service, 2003, p. 9). Disturbance near winter roost sites is not likely to occur in any alternative because invasive plant treatments generally do not occur during the winter and PDF J1b will minimize or eliminate the source of disturbance near winter roosts.

Effects of Herbicides

Herbicides and surfactants applied according to PDFs, pose no risk to bald eagles. Bald eagles are not likely to be directly sprayed, or encounter vegetation that has been directly sprayed, because no aerial application is proposed. No ground applications of herbicide would reach the upper canopies of mature trees where bald eagles nest.

The potential for the herbicides to adversely affect bald eagles was determined using quantitative estimates of exposure from worst-case scenarios. The dose estimates for fish-eating birds were calculated using herbicide or NPE concentrations in fish that have been contaminated by an accidental spill of 200 gallons into a small pond. Assumptions used include no dissipation of herbicide, bioconcentration is equilibrium with water, contaminant level in whole fish is used, and upper estimate assumes 15 percent of body weight eaten/day. For chronic exposures, we used a scenario where the bird consumes fish from water contaminated by an accidental spill over a lifetime. All estimated doses used in effects analysis were the upper levels reported in the Forest Service/SERA risk assessments.

The following interpretations of the exposure scenario results are made with the reservation that toxicity data was generated from laboratory animals, which may not accurately represent potential effects to free-ranging wildlife.

The results of these exposure scenarios indicate that no herbicide or NPE surfactant poses any plausible risk to birds from eating contaminated fish. All expected doses to fish-eating birds for all herbicides and NPE are well below any known No Observable Adverse Effect Level (NOAEL - see R6 2005 FEIS, Appendix B). The weight of evidence suggests that adverse effects to bald eagles from NPE or the herbicides included in the action alternatives are not plausible.

Townsend's big eared bat

This bat is known to have roosts on bridges within or near treatment areas. Traffic along the roads and the bridges used for roosting was well-established when the bats colonized the bridges. Roadside treatments typically consist of a boom or nozzle spray attached to a pick-up truck, or a person with a backpack sprayer conducting spot sprays of plants. Both treatment methods only take a couple minutes to conduct, do not generate noise much beyond the background noise of the road and bridge use, and do not occur in close proximity to the bats themselves. Therefore, the likelihood of disturbing roosting bats during treatment of roadside invasive plants is remote. Invasive plant treatments in the treatment areas near bridges known to be utilized by Townsend's big-eared bats are not likely to adversely impact Townsend's big-eared bats.

The bats forage over large areas catching insects (primarily moths) in flight or by gleaning from vegetation. The small amount of acreage proposed for treatment, scattered in small patches, make it unlikely that the bats would forage within treatment areas and on insects that have been inadvertently sprayed by herbicides and NPE surfactant. If contaminated insects were ingested, only NPE surfactants resulted in a dose that exceeds the toxicity index. In order to receive this dose, the bat would have to consume nothing but contaminated insects for an entire nights feeding. Given the bats foraging habits, it is unlikely that bats would be exposed to this level of NPE. In addition, because the bats roost in crevices well above ground level during the day, it is not plausible that they could be directly exposed to spray of herbicides or NPE.

Data is lacking on risk from chronic exposure to contaminated insects. The likelihood of a chronic exposure to contaminated insects is remote, given the small acreages treated and the relatively large areas in which bats forage.

The bats are not likely to forage exclusively within treated areas over a 90-day period (the chronic exposure) so there does not appear to be a plausible risk from chronic exposure. Therefore, "no impact" to Townsend's big-eared bats will occur for all action alternatives.

Mazama (Olympic) Pocket Gopher

Mazama (Olympic) pocket gopher is not known to occur on the Olympic National Forest, but there may be suitable habitat within the higher elevations in Buckhorn Wilderness. Treatment areas 9H-01 and 9H-Three O'Clock Botanical Area are adjacent to the wilderness, but occur at the lower elevations than inhabited by Mazama pocket gophers. Since there are no proposed treatment areas within suitable habitat, no alternatives would impact the Mazama pocket gopher.

Common Loon

The loon has been documented on Lake Quinault and Wynoochee Lake within Olympic National Forest system lands. They are winter visitors and are not known as breeding residents. Proposed invasive plant treatment sites (9P-32, 9P-32a, and 9H-27) are located within Forest Service campgrounds that are adjacent to Lake Quinault and Wynoochee Lake. Invasive plant treatments are planned to be a combination of herbicide and manual techniques and would occur during spring and summer. No dose of herbicide or NPE exceeded toxicity indices even in a "worst case" scenario. Since the treatments would occur when loons are not likely to be present, and herbicide effects are not plausible, there will be "no impact" to common loons from proposed treatments, regardless of alternative chosen.

American Peregrine Falcon

No current nest sites for peregrine falcon occur within 1.5 miles of any proposed treatment area, the mandatory PDF will avoid disturbance, and no herbicide or NPE dose exceeded the toxicity indices for fish-eating birds even in a "worst case" scenario, so there would be "no impact" to peregrine falcons regardless of alternative chosen.

Cope's giant, Olympic Torrent and Van Dyke's Salamander

The Copes' giant and Olympic torrent salamanders are highly aquatic and found in streams. There are 12 known sites for Cope's giant salamander documented on the Olympic National Forest, but none occur within treatment areas. There are 27 known sites for the Olympic torrent salamander on National Forest system lands, 2 of which are in treatment areas. Van Dyke's salamander is associated with moist areas, including streams, seeps, and springs and is active when soil moisture is high and temperatures are cool. There are 22 known sites for Van Dyke's salamander on the Olympic National Forest, 1 of which is within a treatment area.

Suitable habitat for all three of these salamanders exists on the forest; much of it has not been surveyed. Suitable habitat has not been mapped but can be considered to be most closely associated with riparian areas. For purposes of this analysis, the Aquatic Influence Zone (the inner half of Riparian Reserves) is used as an indicator of suitable salamander habitat that has not been surveyed. This will greatly overestimate the actual suitable habitat for these rare salamanders, which have quite specific habitat associations. Treatments are proposed for approximately half of one percent of Aquatic Influence Zones across the Forest.

Mechanical treatments near streams and springs can create ground disturbance that could introduce silt into salamander habitat, potentially clogging the gills of the salamanders and resulting in mortality. Little is known about the effects of herbicides other than the potential for herbicides to cause mortality or result in malformations of amphibian larvae. Effects of herbicides to amphibians are discussed in the Appendix P of the R6 2005 FEIS (pp. 28-31).

Project Design Features H1, H1a, H6-11, and J5 limit broadcast application of herbicides would minimize exposure of salamanders to the herbicides most likely to have adverse effects. Limiting broadcast application of herbicides within potential salamander habitat reduces the likelihood and amount of herbicide that could contaminate water, soil or rocks used by salamanders. Broadcast spray buffers apply wherever and whenever water is present, which is where and when salamanders are most likely to occur. In addition, there is little overlap between the habitat for these salamanders and locations of infestations to be treated, as suggested by the Aquatic Influence Zone acres described above. Most invasive plants occur in more open, drier, and previously disturbed sites.

Because there is minimal overlap between actual treatment sites and salamander habitat, and project design feature minimize exposure to herbicides, this project may adversely impact individuals, but is not likely to lead to a trend toward federal listing of these salamanders.

Puget Oregonian, Hoko Vertigo, Malone Jumping Slug, and Blue-Gray Taildropper

These four mollusks are not located within any treatment areas, and likely do not occur on Olympic National Forest System lands, so there would be “no impact” to these mollusk species from any alternative.

Burrington’s and Warty Jumping Slug

Both these mollusks are associated with a variety of moist forest and they retreat into down wood, leaf litter and moist areas during the dry summer months (May or June through September). There are 10 known sites for Burrington’s jumping slug on the Olympic National Forest, 8 of which are within treatment areas that may have herbicide use. The warty jumping slug is locally common and abundant with 605 known sites on the Olympic National Forest; 478 (or 79 percent) of which are within treatment areas that may have herbicide use. The majority of the proposed treatment areas are along disturbed roadsides that do not provide suitable habitat for these mollusks. Roadsides conditions are more dry and harsh than is suitable for mollusks. While many known site locations coincide with treatment areas, the actual invasive plant treatments would occur in microhabitats that are not suitable for mollusks (Joan Ziegltrum, personal communication, 2006). Mollusk habitat and populations occur off the roads in adjacent suitable habitat.

No invasive plant treatments will remove habitat for jumping slugs nor will treatments cause large-scale microclimate changes within their suitable habitat. Habitat components for jumping slugs, such as down logs, will remain in place on treatment sites.

In all action alternatives, PDF J-6 requires that treatments avoid known sites or high potential habitat when soil moisture is high and these slugs are most likely to be at or near the surface. This will minimize their exposure to herbicides and reduce the risk of mortality by trampling. Most mechanical and herbicide treatments would occur along disturbed roadsides, which are often drier conditions and not suitable mollusk habitat (Joan Ziegltrum, personal communication, 2006). Although the Project Design Features minimize risk to these species from manual, mechanical, and herbicide treatments, all action alternatives may adversely impact some individuals, but would not likely to lead to a trend toward federal listing.

Table 49-Impact Determinations for Sensitive Wildlife Species

Wildlife Common Name	Impact Determination
Townsend’s Big-Eared Bat	No Impact
Mazama Pocket Gopher	No Impact
Common Loon	No Impact

Wildlife Common Name	Impact Determination
American Peregrine Falcon	No Impact
Bald Eagle	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Vandyke's Salamander	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Cope's Giant Salamander	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Olympic Torrent Salamander	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Puget Oregonian	No Impact
Burrington's Jumping Slug	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Warty Jumping Slug	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Malone's Jumping Slug	No Impact
Blue-Gray Taildropper	No Impact
Hoko Vertigo	No Impact

Direct and Indirect Effects on Survey and Manage Species

As discussed previously, the Burrington's jumping slug is the only wildlife species currently included in the Survey and Manage list that is likely to occur on the Olympic National Forest. Other species are listed for Survey and Manage, but have not been detected on the Olympic National Forest in any previous or ongoing survey. Further discussion on these species is in Appendix C. Effects to the Burrington's jumping slug are discussed above under Direct and Indirect Effects to Regional Forester Sensitive Species.

Surveys for Burrington's jumping slug are unlikely to be needed for this project, particularly within roadside treatment areas. The 2001 Survey and Manage ROD (USDA and USDI 2001, p. 22) states, "The line officer should seek specialists' recommendations to help determine the need for a survey based on site-specific information. In making such determination, the line officer should consider the probability of the species being present on the project site, as well as the probability that the project would cause a significant negative effect on the species habitat or the persistence of the species at the site." Pre-project surveys for Burrington's jumping slug are not required for roadside treatment areas, regardless of alternative, for two reasons:

1. These areas are not considered suitable habitat (Ziegltrum, Forest Ecologist, personal communication 2006).
2. Roadside treatment would not negatively impact adjacent suitable habitat or species persistence.

While individual mollusks may be found on roadsides, they would not be there if not for the adjacent [unaffected] natural habitat (2003 USDA/USDI Survey Protocol for Survey and Manage Terrestrial Mollusk Species from the Northwest Forest Plan, v.3.0, 70page). In addition, invasive plant treatments can be considered routine road maintenance similar to cleaning ditches removing encroaching vegetation, which are not considered habitat-disturbing activities in the 2001 ROD (p. 22).

The need for pre-project surveys in other types of treatment sites would be evaluated during the annual implementation planning process (see Section 2.5, Implementation Planning).

Direct and Indirect Effects on Management Indicator Species

The invasive plant treatments proposed in all alternatives focus on treating the target non-native plants and avoid or minimize effects to non-target native vegetation. No treatments will remove native trees or alter native habitat structure. Proposed treatments will improve cover of native plants within treatment areas and could contribute to improved habitat conditions for deer and elk in some select sites. Habitat for pileated woodpecker, primary cavity excavators, and pine marten is not substantially affected by invasive plants, nor would it be affected by invasive plant treatments.

Pileated woodpecker and Primary Excavators

Invasive plant treatments would not affect pileated woodpeckers or the primary cavity excavator group. These birds nest in cavities in dead limbs and forage on trees and shrubs. Black-capped chickadee, Lewis' woodpecker, and flicker may encounter contaminated insects due to their foraging habits.

Appendix P of the 2005 R6 FEIS included an assessment of risk from use of herbicides to insectivorous birds. The exposure scenarios for insectivorous birds indicate that only NPE doses would exceed a threshold of concern in acute exposures at typical application rates. In order to receive this dose, the birds would have to feed exclusively on contaminated insects for an entire day's feeding. The above-mentioned species forage in relatively large areas, sometimes several acres or more, and forage on a variety of plants and locations (e.g. tree limbs and boles, understory shrubs, bare ground, and bird feeders). Proposed broadcast application of herbicides is proposed only along roadsides. Other application methods treat individual plants and are unlikely to contaminate significant amounts of forage insects or seed. The patchy nature of proposed invasive plant treatments would make it unlikely for a single bird to feed exclusively on insects from treated patches, even in roadsides treated with broadcast applications. However, adverse effects on some individual birds cannot be ruled out, due to lack of data on occurrence and foraging area within treatment areas.
Data on chronic exposure of birds to contaminated insects is lacking. Very conservative assumptions regarding herbicide residue on insects would indicate that several herbicides could exceed a threshold of concern in a chronic exposure scenario. However, chronic exposure thresholds of concern were established by daily doses for 90 days or more in laboratory studies. It seems highly unlikely that wild birds would feed exclusively on insects from treated patches of invasive plants along a roadside for the length of time needed to acquire a chronic dose of concern.

The northern flicker regularly forages for ants on the ground and ants can be active during herbicide applications. However, even if a flicker ate contaminated ants, it would have to eat nothing but contaminated ants for an entire day's feeding to be exposed to enough NPE-based surfactant to be a concern. Given that the vast majority of proposed treatments are along roadsides, and that flickers would move among various foraging sites throughout the day, this scenario is not plausible. Given varied diet, foraging strategies, and movement of black-capped chickadees and Lewis' woodpecker, actual doses exceeding level of concern are unlikely.

Northern flying squirrel is arboreal but feeds on underground fungi. It could encounter some contaminated soil or vegetation but it is unlikely to feed exclusively within treated patches of ground. Even if it fed exclusively on contaminated vegetation for an entire day, or on 20 percent contaminated vegetation over 90 days, it would not receive a dose that exceeded any toxicity indices for any herbicide proposed or NPE. Direct spray is not feasible due to the squirrel's arboreal and nocturnal behavior. An herbicide dose of concern is not plausible. None of the action alternatives would alter habitat for these species. No adverse effects are plausible to populations.

Roosevelt elk and Black-tailed deer

Invasive plant treatments will not reduce available habitat for deer or elk, but could contribute to improved habitat quality in the long term (see Rice et al. 1997, for example).

The grazing and browsing habits of elk and deer make it possible for them to consume vegetation that has been sprayed with herbicide. Quantitative estimates of risk using "worst-case" scenarios found that none of the herbicides considered for use, at typical application rates, would result in a dose that exceeds the toxicity indices in either acute or chronic scenarios. The dose for NPE surfactant exceeds the toxicity index only in an acute scenario. The deer or elk would have to consume an entire day's diet of contaminated grass in order to receive this dose. Deer and elk do not forage extensively on the invasive plants found on the Olympic National Forest, they are not likely to forage exclusively on the patches of invasive plants that have been treated with herbicide, and the treated sites comprise a very small proportion of the available foraging area for these species. Backpack spot sprays and roadside broadcast applications would only contaminate very small amounts of forage, if any, because forage species are not the target of the applications. The "worst case" exposure scenario for NPE is not plausible for the treatments proposed in any of the alternatives. Therefore, no plausible adverse effects to deer or elk would result regardless of alternative chosen.

Pine Marten

On the Olympic National Forest, pine martens are most likely to occur in remote wilderness areas or contiguous old-growth forest. Most treatment areas are on roadsides and are unlikely to disturb pine martens, do not alter suitable habitat, and are unlikely to expose their prey. Even if pine martens consumed for an entire day nothing but prey that had been directly sprayed, they would not receive a dose that exceeded the toxicity indices for any herbicides or NPE (R6 2005 FEIS, Appendix P). No plausible effects would result from any alternative.

Direct and Indirect Effects to Landbirds

Invasive plant treatments proposed on the Olympic National Forest will not remove habitat of the focal species for coniferous forests. No trees will be removed and forest structure will not be altered by proposed treatments. Only species that forage or nest near the ground are likely to be exposed to disturbance from treatments or herbicides. Of the coniferous forest focal species identified in Altman (1999), the following species are most likely to forage or nest near the ground: varied thrush, Wilson's warbler, winter wren, black-throated gray warbler, Hutton's vireo, olive-sided flycatcher, western bluebird, orange-crowned warbler, rufous hummingbird (Source: Altman 1999, Marshall et al. 2003). Because these species are not reported to nest in invasive plant species targeted for treatment, manual and mechanical treatments are not likely to disturb nests of these species.

As discussed above for Primary Cavity Excavators, analysis in the 2005 R6 FEIS (Appendix P) indicated that only NPE poses a risk to insectivorous birds at typical application rates for acute exposures. Exposures resulting in a dose of concern do not appear plausible for the proposed treatments, as detailed above for Primary Cavity Excavators, although risk to some individual birds cannot be ruled out.

In conclusion, invasive plant treatments will not alter habitat for focal species in the Partner's In Flight land bird conservation strategy. Manual and mechanical treatments are not likely to disturb nests of focal species. Some individuals of focal species could be exposed to herbicides by foraging on contaminated insects, but the likelihood of any dose of concern is remote.

Direct and Indirect Effects to Birds of Conservation Concern

For all species included in the Birds of Conservation Concern, invasive plant treatments proposed on the Olympic National Forest will not remove or degrade their habitat. Removal of invasive plants will likely contribute to the integrity of habitat areas, although no specific habitat elements for these species are currently being affected by invasive plants on the Olympic National Forest.

The black swift and olive-sided flycatchers are insectivorous birds. They do not nest in close proximity to the ground and are not sensitive to the short-term disturbance that most invasive plant treatments would create. The exposure scenarios for insectivorous birds indicate that only NPE doses would exceed a threshold of concern in acute exposures at typical application rates (see 2005 R6 FEIS, Appendix P). In order to receive this dose, the birds would have to feed exclusively on contaminated insects for an entire day's feeding. Black swifts feed primarily on flying aquatic insects like mayflies, stoneflies, and caddis flies, catching them high in the air. These insects are unlikely to be directly sprayed because broadcast spray of herbicide is limited or prohibited in their habitats. Therefore, any exposure of concern for black swift is unlikely. Olive-sided flycatchers also catch their flying insect prey high in the air, launching from a high perch in a snag or tree. Proposed broadcast spraying is along infested roadsides and the infestations occur in patches rather than long solid infestations. The patchy nature of proposed invasive plant treatments would make it unlikely for a single flycatcher to feed exclusively on insects from treated patches. While some of their insect prey may become contaminated by broadcast spraying, it seems unlikely that they would forage exclusively on contaminated insects. Chronic doses are even more unlikely, as described above in the effects to Landbirds. Therefore, negative effects to olive-sided flycatchers are unlikely.

The rufous hummingbird inhabits open areas and meadows, catching insects and sipping nectar. A small amount of exposure to herbicides or NPE could amount to a dose of concern because of the very small body size of the rufous hummingbird. These hummingbirds could forage in open areas where invasive plants have been treated and possibly glean contaminated insects. It is unlikely that they would forage exclusively within a patch of invasive plants. These hummingbirds are not known to heavily utilize invasive plants for a nectar source and they prefer tubular flowers where the nectar is deep inside the corolla. Native forage plants would not be treated so the nectar is unlikely to be contaminated with herbicide. Rufous hummingbirds breed from Alaska south to Oregon. The patchy nature of the invasive plant infestations and the multi-state breeding range for this bird indicate that while adverse effects to some individual birds cannot be ruled out, there is not likely to be any population-level effect to the species from proposed invasive plant treatments on the Olympic NF.

Herbicide Use and Amphibian Decline

Information on the effect of pesticides on amphibian populations is limited, and the studies that are available often focus on the most toxic compounds like insecticides (e.g. Taylor et al. 1999, Bridges and Semlitsch 2000, Boone and Semlitsch 2001, Relyea and Mills 2001). Some herbicides are known to have adverse effects on amphibians (e.g. Hayes 2002, Wojtaszek et al 2005).

To date, atrazine is the only herbicide active ingredient that has been implicated in overall amphibian declines (Hayes 2002). This herbicide is not proposed for use in this project.

Relyea (2005) implicate the glyphosate formulation Roundup in amphibian decline, but the formulation studied contains a toxic surfactant. Numerous previous studies have attributed the toxicity of this formulation to the surfactant and not the glyphosate active ingredient (e.g. Mann and Bidwell 1999; Perkins et al. 2000).

The pesticides investigated (e.g. carbaryl, PCB's, atrazine) all have much higher propensity to accumulate in the fatty tissues than the herbicides proposed in this document. For example, Atrazine has an octanol/water partition coefficient (Kow) of 481 while the highest Kow for any herbicide proposed is 45.1 for sethoxydim, and all the other herbicides have Kow ranging from 2.1 to much less than 1. There is a substantial data gap regarding effects of the herbicides included in this analysis and the potential for effects to amphibian populations, but current data on these herbicides do not suggest a risk to amphibian populations because they do not accumulate in animal tissues and are less persistent, less mobile, and less widely used than pesticides that have been implicated in amphibian declines.

Project design features and buffers have been proposed that respond to uncertainty about effects to amphibians from herbicide exposure. Broadcast spraying is prohibited and selective application methods are specified near streams, and the herbicide ingredients that can be used are limited within certain distances of amphibian habitat.

Cumulative Effects Analysis for All Alternatives

The Project Design Features common to all action alternatives are likely to effectively reduce risk of adverse effects to terrestrial wildlife because they minimize or eliminate disturbance and herbicide exposure scenarios of concern. The types of treatments that are proposed, implemented according to Project Design Features, have a low likelihood of contributing to cumulative effects from other projects on and off the Olympic National Forest. Invasive plant treatments are likely to have an overall beneficial impact to wildlife to the extent that invasive plants are replaced with native vegetation. All of the environmental standards, policies and laws related to wildlife would be met in all alternatives.

3.4 Soils and Water

3.4.1 Introduction

The effect of invasive plant treatment on soils and water is a primary public issue (Issue Group 5). Federal and state laws, policies and regulations control the use of herbicides on National Forest System lands, including the Clean Water Act and the Federal Water Pollution Control Act. Section 208 of the 1972 amendments to the

Federal Water Pollution Control Act (Public Law 92-500) specifically mandated identification and control of non-point source pollution. Clean Water Act Section 303(d) directed the State of Washington to list Water Quality Limited Waterbodies (listed streams) and develop Total Daily Maximum Loads (TMDL) to control the non-point source pollutant causing loss of beneficial uses.

The Olympic National Forest has completed a TMDL for the Upper Humptulips Watershed (includes the West Fork Humptulips and East Fork Humptulips Watersheds). The Forest and Washington Department of Ecology have discussed development of a Forest-wide TMDL, but have not yet set dates to initiate development of this plan.

The Olympic National Forest Plan (USDA 1990 as amended by the 1994 Northwest Forest Plan ROD, and the R6 2005 ROD) provides direction to protect and manage resources. The Forest Plan Goal for soils is to "Protect, conserve, and enhance the long-term productivity of forest soils for the multiple uses of the Forest". Forest Plan Goals for water resources are to "provide water quality needs for municipal and domestic supply, and to protect rivers, streams, shorelines, lakes, wetlands, flood plains, and other riparian areas during implementation of management activities."

Forest Management Objectives for soil, riparian areas and water resources include IV-12 and IV-18:

- The primary goal for water quality is to provide high quality water by minimizing soil erosion and the introduction of chemicals and bacteria.
- All riparian areas are to be managed to protect and maintain their unique values as they relate to wildlife, fish habitat and water quality.

This project would comply with all Washington State water quality standards and requirements detailed in Water Quality Standards for the State of Washington, Chapter 173-201A WAC 1997 & 2003 and Forest Chemicals Chapter 222-38 WAC.

Waters on the Olympic National Forest are considered AA (extraordinary) under State of Washington 173-201A120 list. Beneficial uses for these waters include:

- Water Supply (Domestic, Industrial, Agricultural)
- Stock Watering
- Commerce and Navigation
- Wildlife habitat
- Recreation
- Salmonid, clam, oyster, mussel, crustacean and other shellfish migration, rearing, spawning, and harvesting.

3.4.2 Affected Environment

Geology and Soils

The geology of the Olympic National Forest is complex. The bedrock is a combination of volcanic and sedimentary rocks, altered by planetary plate tectonics and heavily eroded by glaciation and runoff, leaving deep glacial deposits in the larger valleys.

Uplift is ongoing and many steeper slopes are unstable and prone to mass movements. Many of the volcanic and sedimentary rocks are highly deformed and fractured. Where these fractures are exposed they can have high permeability, which may serve to transfer herbicide from soils to groundwater.

Soils are formed from four broad categories of parent materials. These are: (1) recent alluvium; (2) glacial deposits; (3) hard sedimentary and meta-sedimentary rocks; and (4) hard volcanic and meta-volcanic rocks.

There are 183 different soil types within areas containing invasive plants. Of particular concern for the Olympic National Forest are the soils listed as hydric (poorly drained, have a high groundwater table or are frequently ponded or flooded). Potential hydric soils were identified from the Olympic Soil Resource Inventory (SRI) soils layer on floodplains and low stream terrace sites, glacial deposits and small wet depressions with a high seasonal water table. Approximately 684 acres of hydric soils are within treatment areas, with about 110 acres estimated as being infested.

Invasive plants can affect soils in many ways. They can cause changes in soil properties such as pH, nutrient cycling and changes in composition or activity of soil microbes. For example, spotted knapweed has been implicated in reducing available potassium and nitrogen (Harvey and Nowierski, 1989).

A reduction in soil nutrient levels makes it difficult for native plants to compete with invasive plants, and may also affect the soil biotic community. The long-term effects of these changes are not known. Indirect effects of changes in soil biology include sedimentation of streams and reduced recharge rates for groundwater.

Presence of non-native plants also leads to changes in the mycorrhizal fungus community (ibid). Plants and mycorrhizal fungi are strongly dependent on each other, and species of fungi are associated with specific plants. These changes could increase the difficulty of reestablishing native vegetation after the invasive plants are removed.

Municipal Watersheds and Domestic Water Supplies

There are nine municipal watersheds on the Olympic Forest that range in size from 293 acres to 108,785 acres (two watersheds for the City of Port Townsend have been combined in Table 50). An estimated 210 acres are currently infested within municipal watersheds. These invasives are found primarily along roads and in plantations and other disturbed areas. The Lake Sutherland Water District water intake is potentially within 1,000 feet downstream of a treatment area. All other municipal watershed intakes are at least 1,000 feet downstream from proposed treatment areas.

To be classified as a municipal watershed, a water source must meet one of the following criteria: 1) at least 25 individuals are served at least 60 days per year, or 2) at least 15 service connections are provided.

The 1990 Olympic National Forest Plan states that the primary goal for municipal watershed management is to provide high quality water by minimizing soil erosion and the introduction of chemicals or bacteria. A Forest Plan standard for municipal watersheds states:

> "Herbicides and pesticides should not be used. Chemicals should be used as a last resort, and only when site-specific analysis indicates water quality will not be adversely affected."

The Olympic National Forest has not used herbicides in municipal watersheds since this standard was adopted in the Forest Plan in 1990. Since that time, the invasive plant problem has grown, and new chemical methods of treatment have become available. The type of treatments proposed for municipal watersheds are not likely to adversely affect drinking water quality due to the low amount of herbicide use overall, the characteristics of the herbicides proposed for use and the cautious way that they would be applied. Infestations of invasive plants in most municipal watersheds are minimal, except for the large watersheds serving Sequim and Port Townsend (Table 50).

Municipal watersheds are governed by agreements (on file at Olympic National Forest). Two of the agreements specifically mention herbicides:

> **City of Port Townsend** - "Until such time as the Cooperative Watershed Protection Program is fully implemented, the Forest Service shall not use any pesticides or herbicides within the watershed without the city's concurrence."
> **City of Aberdeen** - "The use of herbicides are not contemplated in this open water source watershed. However, in the event herbicides are needed to control a catastrophic outbreak of insects, the City and the public will become involved in the decision-making process."

Herbicide use within these watersheds would need to be coordinated with the city watershed managers. Less than one acre is currently known to be infested in the City of Aberdeen watershed.

Table 50-Acres of Invasive Plants in Municipal Watersheds

Municipal Watershed	Acres of Infestation Proposed for Treatment	Water Source
Black Diamond Water District	<1	South Branch Little River
City of Aberdeen	<1	Wishkah River
City of Port Townsend	51	Little Quilcene River; Big Quilcene River
City of Sequim	135	Dungeness River
Iskra Bros. Logging Company Water System	8	Twin Culvert
Lake Sutherland Water District	14	Falls Creek
Meadowland Water Association	<1	Hathaway Creek
Neilton Cooperative Water Company	<1	McCall Creek
Total	**Approximately 212 acres**	

In addition to the municipal watersheds, there are approximately 113 appropriated Washington State Surface Water Rights for on and off-forest water withdrawals. There are 30 special use permits for surface water intakes on National Forest System lands for individual homes. These intakes are used for fish propagation, irrigation and domestic water sources.

Approximately 50 forest campgrounds, work sites and guard stations use surface or ground water sources on the Olympic National Forest; a map showing locations of both the municipal watersheds and the forest water sources is in the project record. Validation of the water rights is underway on the Forest.

Washington State law 246-290-315 requires that herbicide use be avoided within 100 feet of wells and 200 feet of springs used as domestic water sources.

Clean Water Act

Approximately 23,377 miles of streams flow on the Olympic National Forest. Approximately 30 percent are perennial and 70 percent are intermittent. The Washington State 303(d) list of water quality limited streams lists seven streams (21 segments) on the Forest for temperature (Table 51). None of the water quality limited streams on the Forest are listed for chemical contaminants.

Table 51-Streams on the 303(d) List for Temperature

Stream Name	Within Treatment Area?
Calawah River S.F.	No
Deep Creek	No
Lebar Creek	Yes
Matheny Creek	Yes
Sams River	No
Sitkum River	Yes
Skokomish River S.F.	No

Three 303(d) listed streams are within treatment areas. The Sitkum River flows through treatment area 9P-27. Lebar and Matheny Creek flow through areas 9H-18 and 9P-27 respectively, both with roadside treatments. The main invasive plants to be treated at these sites are Canadian thistle, bull thistle, tansy ragwort and scotchbroom. None of these target species provide any stream shade that would have a positive affect on stream temperature or riparian habitat.

Aquatic Conservation Strategy

The Aquatic Conservation Strategy (ACS) is an integral part of the 1994 Northwest Forest Plan. The ACS was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems within public lands. The ACS is intended to meet several objectives toward meeting the goal of healthy ecosystems and watersheds. Aquatic Conservation Strategy Objectives are applied over time at watershed and broader scales.

The Aquatic Conservation Strategy established a system of Key Watersheds to protect areas of high water quality and habitat for wild fish populations. Key Watersheds are intended to serve as refugia for at risk stocks of native and anadromous fish. Activities to protect and restore aquatic habitat in Key Watersheds are higher priority than similar activities in other watersheds. About 70 percent of the invasive plant sites are sparsely distributed within Key Watersheds.

Watershed analysis has been conducted between 1994 and 2005 for South Fork Skokomish River, Sitkum and South Fork Calawah River, North Fork Calawah River, Matheny Creek, Boulder and Cooks Creeks, Big Quilcene River, Hamma Hamma River and Hood Canal tributaries, East and West Forks Humptulips River, Quinault River, Snow and Salmon Creeks, Upper Wynochee River, Salmon River, Sams River, Dosewallips River, Soleduck River, Deep Creek and East and West Twin Rivers, Dungeness River and the West Fork Satsop River. Appropriate treatment is urged in Watershed Analysis documents that address noxious weeds or other non-native invasives.

Table 52 displays the relative distribution of the invasive plants at the 6^{th} field watershed scale. In many of these watersheds there are fewer than ten acres of invasive plant sites. Key Watersheds are italicized.

Table 52-Sixth Field Watersheds on Olympic National Forest

Sixth Field Watersheds	National Forest Systems Lands within each Watershed		Infested Acres	Infested Acres in Riparian Reserves
	Acres	Percent of Watershed29		
Big Creek/Upper Quinault River	8,479	24	0.5	0.07
Bockman Creek	3,679	22	1.9	0.57
Calawah River	2,065	21	0.3	0.08
Canyon Creek/Pats Creek	8,230	41	91.4	24.98
Cook Creek	8,082	27	28.3	7.71
Crescent Lake/Lyre River	1,964	5	2.3	0.19
Deep Creek	5,483	44	82.4	29.16
East Fork Humptulips River	19,508	66	184.2	67.48
East Twin River	4,095	33	2.8	0.79
Fulton Creek/Waketickeh Creek	7,332	43	39.6	7.78
Headwaters Sol Duc River	9,539	28	66.1	13.77
Hoko River	344	1	< 0.1	0
Jefferson Creek	12,866	92	108.5	45.39
Jimmy-Come-Lately Creek	9,010	73	5.1	1.54
Lilliwaup Creek	2,546	8	42.4	8.20
Little Quilcene River	9,989	44	28.8	6.28
Lower Big Quilcene River	8,061	61	2.8	1.00
Lower Bogachiel River	5,724	12	0.2	0.08
Lower Dosewallips River	21,553	60	17.6	5.66
Lower Duckabush River	14,295	70	49.7	15.43
Lower Elwha River	5,719	31	1.5	0.11
Lower Gray Wolf River	12,400	79	3.9	0.79
Lower North Fork Skokomish River	2,698	17	27.5	4.71
Lower Sol Duc River	2,996	11	0.1	0.04
Lower South Fork Skokomish River	16,145	57	69.6	24.67
Mainstem Hamma Hamma River	28,207	71	110.9	37.72
Matheny Creek	20,338	84	79.6	22.84
McDonald Creek/Siebert Creek	2,588	7	0.6	0.11
Middle Clearwater River	250	1	0.1	0.01
Middle Dungeness River	14,693	100	9.9	1.86
Middle Fork Satsop River	13,023	34	89.4	26.15
Middle Hoh River	413	1	12.6	3.27
Middle North Fork Skokomish River	13,206	48	81.5	19.90
Middle Queets River	3,258	15	4.3	1.22
Middle Quinault River	6,208	13	42.9	9.2
Middle Sol Duc River	14,047	47	128.1	48.22
Middle Wynoochee River	13,426	32	39.0	7.14
North Fork Calawah River	19,267	63	237.9	69.98
Pysht River	4,876	14	1.2	0.39
Quinault Lake	13,684	56	274.9	89.49
Salmon River	5,789	28	13.1	3.52

[29] National Forest System lands comprise a portion of each watershed. The remainder of the watershed is managed by the National Park Service, Tribal Governments, private landowners, etc..

Sixth Field Watersheds	National Forest Systems Lands within each Watershed		Infested Acres	Infested Acres in Riparian Reserves
Sams River	16,170	82	8.0	1.07
Sequim Bay Tributaries	89	1	< 0.1	0
Snow Creek/Salmon River	7,724	31	27.7	7.78
South Fork Calawah River	27,463	59	436.9	211.16
Spencer Creek/Marple Creek	4,616	46	8.7	1.96
Stevens Creek	1,644	6	9.8	3.59
Tshletshy Creek	188	1	0.0	0
Upper Big Quilcene River	30,333	96	33.2	5.31
Upper Bogachiel River	10	<1	0.1	0
Upper Duckabush River	1,253	4	<0.1	0
Upper Dungeness River	20,296	65	119.3	13.54
Upper North Fork Skokomish River	5,096	16	0.9	0.10
Upper Sol Duc River	15,625	68	246.1	47.26
Upper South Fork Skokomish River	36,733	95	121.4	39.49
Upper West Fork Satsop River	20,135	52	213.9	94.53
Upper Wishkah River	1,412	6	0.5	0.03
Upper Wynoochee River	24,677	94	125.7	31.27
West Fork Humptulips River	33,826	72	265.4	96.80
West Twin River	4,934	61	222.3	88.90
Total	**630,610**		**3,380**	**1,251**

Riparian Reserves in Treatment Areas

Table 53 displays the estimated infested acres by treatment area. Total treatment areas range from 9 (distinct invasive plant population) to more than 4,000 acres (roadsides). The average treatment area size is about 600 acres. Riparian reserves are estimated to average 33 percent of treatment area acreage. The distribution of infested sites within the treatment areas and riparian reserves is scattered. An average of seven percent of each treatment area is estimated to currently have invasive plants. These populations are small and scattered and are not concentrated in any one riparian area.

Table 53-Treatment Area Information

Treatment Area	Total Treatment Area Acres	Treatment Area Acres in Riparian Reserves	Estimated Infested Acres	Estimated Infested Acres in Riparian Reserves
9H-01	1,319	368	6.5	1.8
9H-02	277	43	80.3	12.5
9H-03	254	99	2.9	1.1
9H-04	267	80	2.0	0.6
9H-05	1,484	408	27.4	7.5
9H-06a	269	58	1.2	0.3
9H-06b	419	93	1.7	0.4
9H-06c	302	72	28.5	6.8
9H-07	315	104	65.8	21.7
9H-08a	642	137	3.6	0.8
9H-08b	421	141	17.2	5.8
9H-09b	3,358	911	1.6	0.4
9H-10	788	210	2.6	0.7

Treatment Area	Total Treatment Area Acres	Treatment Area Acres in Riparian Reserves	Estimated Infested Acres	Estimated Infested Acres in Riparian Reserves
9H-11	255	88	16.4	5.7
9H-12	24	0	6.8	0.0
9H-13	1,269	394	49.7	15.4
9H-14	799	163	31.7	6.5
9H-15	440	125	119.2	33.9
9H-16a	471	142	1.9	0.6
9H-16b	389	201	106.6	55.1
9H-17	689	139	80.7	16.3
9H-17a	333	58	33.4	5.8
9H-18	765	242	23.3	7.4
9H-19	153	60	1.2	0.5
9H-20	424	132	38.8	12.1
9H-21	501	54	16.5	1.8
9H-22	194	36	8.9	1.7
9H-23	1,571	603	63.5	24.4
9H-24	268	46	174.4	29.9
9H-25	1,033	464	269.0	120.8
9H-25a	176	102	36.4	21.1
9H-26	613	170	21.8	6.0
9H-27	187	48	0.7	0.2
9H-28	51	16	26.7	8.4
9H-29 Buckhorn BA	3,076	185	44.7	2.7
9H-30	57	24	7.3	3.1
9H-31	9	9	9.3	9.3
9H-32	21	18	20.8	17.8
9H-Cranberry Bog BA	105	35	6.1	2.0
9H-Pats Prairie BA	410	70	0.2	0.0
9H-Three O'Clock BA	480	63	0.1	0.0
9H-Three Peaks BA	865	138	1.7	0.3
9H-Tyler Peak BA	346	116	0.7	0.2
9H-Wet Weather Ck BA	1,066	167	4.6	0.7
9P-01	411	110	1.9	0.5
9P-02	315	90	0.4	0.1
9P-03	4,294	1,876	28.6	12.5
9P-04	100	32	100.0	32.0
9P-05	471	112	292.5	69.6
9P-06	401	96	1.9	0.5
9P-06a	117	6	2.2	0.1
9P-07	297	42	0.9	0.1
9P-08	291	96	6.5	2.1
9P-09	1,012	271	182.8	49.0
9P-10	1,042	226	67.1	14.6
9P-11	352	144	2.3	0.9
9P-12	1,211	226	17.0	3.2
9P-13	303	70	0.4	0.1
9P-14	316	104	137.1	45.1
9P-15	849	186	31.0	6.8
9P-16	465	146	0.4	0.1

Treatment Area	Total Treatment Area Acres	Treatment Area Acres in Riparian Reserves	Estimated Infested Acres	Estimated Infested Acres in Riparian Reserves
9P-17	398	176	145.5	64.3
9P-18	418	201	1.7	0.8
9P-19	380	180	288.6	136.7
9P-19a	300	19	67.6	4.3
9P-20	281	62	47.3	10.4
9P-21	217	67	0.3	0.1
9P-22	68	13	0.6	0.1
9P-23	188	65	11.3	3.9
9P-24	735	277	17.2	6.5
9P-25	269	8	12.5	0.4
9P-26	543	200	29.8	11.0
9P-27	909	225	19.1	4.7
9P-28	249	52	4.0	0.8
9P-29	209	23	6.7	0.7
9P-30	53	10	44.1	8.3
9P-31	98	7	18.1	1.3
9P-32	120	92	95.8	73.4
9P-32a	93	34	92.7	33.9
9P-33	2,045	630	50.3	15.5
9P-34	308	94	81.6	24.9
9P-35	188	56	55.1	16.4
9P-36	517	206	20.1	8.0
9P-37	1,159	412	95.6	34.0
9P-38	1,323	501	96.8	36.7
9P-39	164	12	1.5	0.1
9P-40	119	29	4.9	1.2
9P-41_POCU	33	9	12.6	3.4
9P-42	325	57	5.2	0.9
9P-43	761	145	12.7	2.4
9P-44	2,320	811	49.9	17.4
9P-45	197	168	38.8	33.1
9P-46 Quinault RNA	1,478	355	55.9	13.4
9P-BillsBog BA	49	31	0.7	0.4
9P-MthnyPr BA	151	24	0.3	0.0
9P-MthnyRdg Ba	181	28	0.7	0.1
9P-NF Matheny Ponds BA	107	23	0.3	0.1
9P-PineMt BA	596	103	3.9	0.7
9P-SFkCal BA	123	109	0.7	0.6
Totals	**57,074**	**16,179**	**3,830**	**1,251**

Aquatic Emergent Invasive Plants

Approximately 12.5 acres of Japanese knotweed and 0.2 acres of giant knotweed are estimated within treatment areas. Japanese knotweed has poor bank holding capacity, which leads to more bank erosion and sedimentation of streams in high winter flows (USDA Forest Service 2005). While knotweed may provide shade, native streamside hardwoods and conifers are much taller, so knotweed dominated areas may be associated with higher water temperatures than areas with native forest communities.

While the known extent of knotweed on the forest is small at this time, knotweed spreads rapidly in flood prone areas such as the Pacific Northwest. Knotweeds tolerate a wide variety of substrates from cobbles to fine soils (Tu and Sol, 2004).

Knotweed is documented as a long standing major invasive plant in Great Britain and throughout the United States; however, it has only been recognized as a major problem for the last five years in the Pacific Northwest. In the eastern United States Japanese knotweed has been found along the banks of the Ohio and Allegheny Rivers and in islands of these rivers where it occupies hundreds of acres of wetlands, stream banks and hillsides (http://www.invasive.org).

Approximately 156 acres of reed canary grass are mapped along streams and wetlands on the Forest. Reed canarygrass is extremely aggressive and often forms persistent monocultures in wetlands and riparian areas. Infestations threaten the diversity of these areas, since the plant chokes out native plants and grows too densely to provide adequate cover for small mammals and waterfowl. Where reed canary grass grows in water, it can slow the movement of water carrying sediment and lead to increased siltation along drainage ditches and streams. Once established, reed canarygrass is difficult to control because it spreads rapidly by rhizomes http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua011.html).

Purple loosestrife is on the Nature Conservancy's list of "worst invasive species." Purple loosestrife, nicknamed the purple plague, is another aggressive invasive species that out-competes native vegetation and forms monocultures. It grows quickly and spreads by roots, stem fragments or seeds (ibid). Like reed canary grass, purple loosestrife can increase fine sediment deposition and decrease channel capacity (USDA Forest Service, 2005). This plant is also found within the project area and occupies streambanks, canals and shallow ponds.

On the Olympic National Forest, if these riparian species continue to grow without being treated, they are expected to continue to spread. Where they spread, banks could become less stable leading to changes in suspended sediment, and substrate character and embeddedness. Potentially this could lead to effects on pool frequency and quality.

Invasive plants can adversely affect the function of riparian areas. If invasive plants replace riparian conifers and hardwood trees, large woody material inputs could be reduced, affecting stream stability, morphology and fish habitat. Himalayan blackberry and knotweed can act as a sediment trap and fish barrier (for more information see Chapter 3.5 Aquatic Organisms).

Streams are complex and dynamic systems that reflect the balance between stream flow, sediment input and substrate/bank composition. Riparian vegetation stabilizes stream banks, and acts as a filter to prevent the run-off of soil into streams. Riparian vegetation also provides large and small wood to streams, adding to habitat complexity and providing cover and food sources for aquatic organisms. Aquatic ecosystems have evolved with certain vegetation types; invasive plants do not necessarily provide similar habitat.

Lakes, wetlands and floodplain areas are often popular for recreation, and so are at risk from invasive plants brought in by visitors. Wetlands can be inundated with water year-round, and others are wet only seasonally. Some areas that are wet only seasonally can be infested with upland invasive species, as well as invasive plants specifically adapted to wetlands. Three acres of wetlands and two acres of floodplains are identified as infested with invasives.

The Forest includes extensive acreage of soils seasonally inundated with water. Approximately 110 acres of these hyrdric soils are identified as infested with invasive plants.

Lake Quinault has many summer homes, and with these homes are a large number of invasive species intentionally or unintentionally planted by summer visitors. These include patches of Japanese knotweed, herb Robert, English ivy and English holly, estimated to cover approximately 96 acres. The Japanese knotweed grows below the high water mark in some places and many of the other infestations are close to the lake. About 26 acres of invasive plants are currently mapped within 100 feet of the lake.

Roads Having High Potential for Herbicide Delivery

Roads are the primary vector for invasive plants to enter the Forest. Approximately 85 percent of the identified invasive plants are along roads or in disturbed areas near roads, such as recreation sites, administrative sites, and skid trails in second growth forest. Native soil has been removed along roads, and fill and surfacing have been placed within the road prism. Ditches have been compacted, allowing them to deliver run-off to streams, which may include herbicides used in broadcast treatments along the roads. Road cutbanks can be a combination of disturbed soil and exposed bedrock. Approximately 16 percent of roadside treatment area acres are within the aquatic influence zone.

The R6 2005 FEIS (Chapter 3.5) describes roadside ditches as an herbicide delivery mechanism; potentially posing a high risk of herbicides reaching concentrations of concern for listed aquatic species. Ditches may extend the stream network and act as delivery routes or intermittent streams during high rainfalls, or as settling ponds following rainfall events.

The 2003 Olympic National Forest Roads Analysis identified roads that pose a high risk to aquatic resources, specifically streams. Aquatic risk factors used to identify high risk roads in the Roads Analysis were: geologic hazard, proximity (delivery) to fish habitat, stream crossing density, stream proximity, and upslope hazard.

Of the five categories used to identify "high aquatic risk" roads, three relate directly to processes that contribute to the potential delivery of herbicides to streams: proximity (delivery) to fish habitat, stream crossing density, and stream proximity. Sediment delivery can be used as a surrogate for herbicide delivery. Thus, these three categories were used to identify roads with high potential for herbicide delivery.

Appendix D includes a list of roads within treatment areas that have a high potential for herbicide delivery. Nearly all watersheds on the Olympic National Forest contain roads that have a high potential for herbicide delivery; invasive plants are widely scattered along these roads. Not all perennial stream crossings are on roads identified as high risk of herbicide delivery.

Roadside treatment areas include compacted ditch lines, disturbed soils, and thin soils near exposed bedrock. Due to the extensive reworking of the properties of soils along roads, the SRI may be misleading for roadside treatment areas. As roads and ditchlines are compacted, roadside soils are assumed to function with a high runoff rate, and PDFs were developed accordingly.

An estimated 1,420 acres of infestations are on roads considered high potential for herbicide delivery. Table 54 displays the infested acres of roadside and other treatment areas and the portions within Riparian Reserves and Aquatic Influence Zones.

Table 54-Infested Acres by Treatment Area Description

Treatment Area Description	Estimated Infested Acres	Infested Acres Likely Within Riparian Reserve	Infested Acres Within Aquatic Influence Zone	Infested Acres within Roadside Treatment Areas High Potential For Herbicide Delivery to Streams
Roadside	3,270	1,051	525	1,420
Administrative Sites, Campgrounds, Summer Homes	130	95	48	0
Meadows, Wetlands, and Floodplains[30]	80	10	6	0
Forests	215	50	25	0
Trails	135	45	23	0
Total Acres	**3,830**	**1,251**	**627**	**1,420**

3.4.3 Environmental Consequences

Effects on Soils

Manual and Mechanical Treatment

Manual and mechanical treatments, along with site restoration activities, are approved in all alternatives. While the relative amounts of such treatments vary between the alternatives, the differences in terms of effects from such treatments are negligible. In lower intensity infestations, non-target vegetation could provide erosion control as well as a seed source for establishing native vegetation. This would be encouraged through restoration activities as needed establish competitive native vegetation post-treatment in areas of bare ground.

Removal of plant roots will break mycorrhizal hyphae in the soil and may cause a transient reduction of mycorrhizal function. Studies on crop plants have shown that leaving an undisturbed mycorrhizal network in the soil after harvest (e.g. zero-till agriculture) significantly increases the nutrient uptake of the subsequent crop (Evans and Miller, 1990). Establishment of native plants may be more successful on undisturbed soil.

Manual removal of plant roots along a streambank may cause some ground disturbance and introduce some sediment to streams. For example, weed wrenching of scotch broom may loosen soil and accelerate erosion in a small area for approximately one season until vegetation was reestablished (scotch broom currently covers about 200 acres within treatment areas, including Cranberry Bog Botanical Area). The amount of sediment likely to be delivered to water from such treatments is nominal compared to the natural, background level of erosion across the Forest.

Mowing may be done in compacted or previously disturbed areas such as roadsides. Soils are not likely to be mobilized from this treatment since the invasive plant root mass will not be displaced through mowing (or other mechanical treatment such as chainsaw work).

[30] These treatment areas contain wet and dry meadows, wetlands and/or floodplains. The treatment area is larger than the meadows, wetlands or floodplains themselves. Some of these areas occur on the drier east side of the Olympic National Forest where Riparian Reserves make up less proportion of a watershed.

Herbicide Treatment

The effect of herbicide treatment to the soil depends on the particular characteristics of the chemical used, how it is applied, and the physical, chemical and biological condition of the soil medium. These characteristics were used to develop the Project Design Features that minimize adverse effects to soil from the use of herbicides. Soil qualities at greatest risk from chemicals are erosion from the removal of ground cover, and damage to soil organisms. General characteristics for the proposed herbicides are displayed below; these were compiled from the R6 2005 FEIS, label information and SERA Risk Assessments.

Chlorsulfuron

Studies on the effects of chlorsulfuron on soil biota include lab and field studies on nematodes; fungi; populations of actinomycetes, bacteria, and fungi; and soil microorganisms.

- No effects of chlorsulfuron were found for soil biota at recommended application rates, with the exception of transient decreases in soil nitrification.
- The ‘no observable effects concentration’ for soil is 10 mg/kg, based on cellulose and protein degradation.
- Chlorsulfuron degrades in aerobic soil.
- Non-microbial hydrolysis plays an important role in chlorsulfuron breakdown, and hydrolysis rates increase as pH increases.
- Adsorption to soil particles, which affects the runoff potential of chlorsulfuron, is strongly related to the amount of organic material in the soil.
- Chlorsulfuron adsorption to clay is low.
- Chlorsulfuron is moderately mobile at high pH.
- Leaching is reduced when pH is less than six.
- Modeling results indicate that runoff would be negligible in sandy or loamy soils.
- In clay soils, off-site loss could be substantial (up to about 55 percent of the applied amount) in regions with annual rainfall rates of 15 to 250 inches.

Clopyralid

Studies of clopyralid effects on soil invertebrates have been conducted, including field studies on the effects to microorganisms.

- Soil concentrations from USDA Forest Service applications are expected to be 1,000 less than concentrations that would cause toxic effects. Therefore, no effects to soil invertebrates or microorganisms are expected from use of clopyralid.
- Clopyralid is degraded by soil microbes, with an estimated half-life of 14 to 29 days.
- Increased soil moisture decreases degradation time.
- Clopyralid is weakly adsorbed and has a moderate leaching potential overall but high leaching potential in sandy soils.
- Modeling results indicate clopyralid runoff is highest in clay soils with peaks after rainfall events.
- Clopyralid percolation is highest in sandy loam soils.

Glyphosate

Numerous soil bacteria, fungi, invertebrates, and other microorganisms have been studied for effects of glyphosate application.

- Studies suggest glyphosate does not adversely affect soil organisms.
- Glyphosate is readily metabolized by soil microorganisms and some species can use glyphosate as a sole source of carbon.
- It is degraded by microbial action in both soil and water.
- Sylvia and Jarstfer (1997) found that after 3 years, pine trees in plots with grassy invasive plants had 75 percent fewer mycorrhizal root tips than plots that had been treated 3 times per year with a mixture of glyphosate and metsulfuron methyl to remove invasive plants.
- Glyphosate degrades in soil, with an estimated half-life of 30 days.
- Glyphosate is highly soluble, but adsorbs rapidly and binds tightly to soil.
- Glyphosate has low leaching potential because it binds so tightly to soil.
- Modeling results indicate glyphosate runoff is highest in loam soils with peaks after the first rainfall.

Imazapic

Imazapic is a relatively new herbicide, and there are no studies on the effects of imazapic on either soil invertebrates or soil microorganisms.

- If imazapic was extremely toxic to soil microorganisms, it is reasonable to assume that secondary signs of injury to microbial populations would have been reported.
- Imazapic degrades in soil, with a half-life of about 113 days.
- Half-life is decreased by the presence of microflora.
- Imazapic is primarily degraded by microbes and it does not degrade appreciably under anaerobic conditions.
- Imazapic is weakly adsorbed in high soil pH, but adsorption increases with lower pH (acidic soils) and increasing clay and organic matter content.
- Field studies indicate that imazapic remains in the top 12 to 18 inches of soil and do not indicate any potential for imazapic to move with surface water.
- Modeling results indicate imazapic runoff is highest in clay and loam soils with peaks after the first rainfall.
- Imazapic percolation is highest in sandy soils.

Imazapyr

There are no studies on the effects of imazapyr on soil invertebrates, and incomplete information on the effects on soil microorganisms.

- One study indicates cellulose decomposition, a function of soil microorganisms, can be decreased by soil concentrations higher than concentrations expected from USDA Forest Service applications.
- There is no basis for asserting adverse effects to soil microorganisms.
- Imazapyr degrades in soil, with a half-life of 25 to 180 days.
- Degradation rates are highly dependent on microbial action.
- Anaerobic conditions slow degradation.
- Adsorption increases with time as soil dries and is reversible.
- Field studies indicate that imazapyr remains in the top 20 inches of soil and do not indicate any potential for imazapyr to move with surface water.

- In forest field studies, imazapyr did not run off and there was no evidence of lateral movement.
- Modeling results indicate imazapyr runoff is highest in clay and loam soils with peaks after the first rainfall.
- Imazapyr percolation is highest in sandy soils

Metsulfuron methyl

Studies on the effects of metsulfuron methyl on soil biota are limited to *Pseudomonas* species, though there are a few studies of insects that live in soil. The lowest observed effect concentration is 5 mg/kg, based on the Psuedomonas study. At recommended use rates, no effects are expected for insects.

- Effects to soil microorganisms appear to be transient
- Metsulfuron methyl degrades in soil, with a variable half-life up to 120 days.
- Half-life is decreased by the presence of organic matter though microbial degradation of metsulfuron methyl is slow.
- Non-microbial hydrolysis is slow at high pH but rapid at lower pH.
- Adsorption to soil particles, which affects the runoff potential of metsulfuron methyl, increased with increased pH and organic matter.
- Metsulfuron methyl has low adsorption to clay.
- Modeling results indicate that off-site movement due to runoff could be significant in clay soils.
- Metsulfuron methyl percolates in sandy soils.

Picloram

Picloram is a restricted use pesticide in the state of Washington, meaning it may only be used by a certified applicator (this is also a standard for all herbicide use on the National Forest). The persistence of picloram increases with soil concentration, thus increasing the likelihood that it becomes toxic to soil microorganisms in the short-term.

- Since picloram is toxic to microorganisms at low levels, toxic effects can last for some time after application.
- Persistence in soils could affect soil microorganisms by decreasing nitrification.
- Long-term effects to soil microorganisms are unknown.
- Picloram applied at a typical application rate is likely to change microbial metabolism, though detectable effects to soil productivity are not expected.
- Field studies have not noted substantial adverse effects associated with the normal application of picloram that might be expected if soil microbial activity were substantially damaged.
- Substantial effects to soil productivity from the use of picloram over the last 40 years have not been noted.
- Picloram has been studied on a number of soil invertebrates.
- Metabolites may increase toxicity for some soil microorganisms.
- Picloram has a typical half-life of 90 days.
- However, picloram soil degradation rates vary in soil, depending on application rate and soil depth.
- Picloram is water soluble, poorly bound to soils that are low in clays or organics, has a high leaching potential, and is most toxic in acidic soil.
- Picloram should not be used on coarse-textured soils with a shallow water table, where groundwater contamination is most likely to occur.
- Picloram percolation is highest in loam and sandy soils. However, modeling results indicate picloram runoff (not percolation) is highest in clay soils.

Sethoxydim

Sethoxydim has not been studied on soil invertebrates.

- Assays of soil microorganisms noted transient shifts in species composition at soil concentration levels far exceeding concentrations expected from Forest Service applications.
- No adverse effects to soil organisms are expected.
- Sethoxydim is degraded by soil microbes, with an estimated half-life of 1 to 60 days. Adsorption of sethoxydim varies with organic material content.
- Modeling results indicate sethoxydim runoff is highest in clay and loam soils with peaks after the first rainfall.

Sulfometuron methyl

There are no studies on the effects of sulfometuron methyl on soil invertebrates. However, it is toxic to soil microorganisms. Microbial inhibition is likely to occur at typical application rates and could be substantial. Soil residues may alter composition of soil microorganisms.

- Sulfometuron methyl mobility is generally greater at higher soil pH and lower organic matter content.
- The typical half-life for sulfometuron methyl varies from 10 to 100 days, depending on soil texture. Half-life decreases as soil particle size decreases. Presence of soil microorganisms also decreases half-life, though microbial breakdown occurs slowly. Sulfometuron methyl degradation occurs most rapidly at lower pH soils where rates are dominated by hydrolysis.
- Modeling results indicate sulfometuron methyl runoff is highest in clay and loam soils with peaks after the first rainfall. Sulfometuron methyl percolation is highest in sandy soils. Monitoring results generally support modeling results.
- Sulfometuron methyl applied to vegetation at typical application rates would probably be accompanied by secondary changes to vegetation that affect the soil microbial community more certainly than direct toxic action of sulfometuron methyl on soil microorganisms.

Triclopyr

The five commercial formulations of triclopyr contain one of two forms of triclopyr, BEE (butoxyethyl ester) or TEA (triethylamine). Triclopyr has not been studied on soil invertebrates.

- Soil fungi growth was inhibited at concentrations 2 to 5 times higher than concentrations expected from USDA Forest Service application rates.
- Triclopyr has an average half-life in soil of 46 days. Warmer temperatures decrease the time to degrade triclopyr.
- Soil adsorption is increased as organic material increases and decreased as pH increases. Triclopyr is weakly adsorbed to soil, though adsorption varies with organic matter and clay content. Both light and microbes degrade triclopyr.

Summary of Soils Concerns and Project Design Features

Table 55 shows the project design features related to use of clopyralid, chlorsulfuron, picloram and sulfometuron methyl so that adverse effects on soil productivity and/or groundwater are avoided or minimized.

Table 55-Soil Property and Project Design Features

Soil Properties of Concern	Special Project Design Features in All Action Alternatives
Chlorsulfuron does not adhere to clay and therefore is available to leach or run off.	H-7 Avoid use of chlorsulfuron on soils with high clay content (finer than loam).
Clopyralid has high potential mobility in sandy soils. It can be persistent in groundwater.	H-6 Avoid use of clopyralid on high-porosity soils (coarser than a loamy sand).
Picloram is persistent in soil and water, and has high potential mobility in sandy soils.	H-8 Avoid use 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.
Sulfometuron methyl is persistent in soil and water, and has high potential mobility in sandy soils.	H-9 Avoid use on shallow or coarse soils (coarser than loam.) No more than one application within a one-year period, except to treat areas missed during initial application.

Effects on Water Quality

Non-herbicide

None of the alternatives have the potential to influence stream flow and channel morphology due to the small portion of any watershed that would be treated. Treating invasive plants such as knotweeds that have colonized along stream channels and out-competed native species would improve riparian stability. All invasive plant treatments bear some risk that removing invasive plants could exacerbate stream instability; the restoration plan accounts for these areas and prescribes mulching, seeding and planting as needed to revegetate riparian and other treated areas.

Manual and mechanical treatments, along with restoration activities within riparian areas could accelerate sediment delivery to streams through ground disturbance. However, most of the treatments areas are previously disturbed roadways and trails so ground disturbance is not a significant concern. Modification of surface ground cover can also change the timing of run-off. For all alternatives, treatment areas comprise a small portion of any watershed and are relatively short-lived.

Herbicide

The routes for herbicide to contaminate water are; direct application, drift into streams from spraying, runoff from a large rain storm soon after application, and leaching through soil into shallow ground water or into a stream. No direct application of herbicide to water is intended in any alternative; however invasive plant treatments in wetlands or stream channels may result in some herbicide entering surface waters. The NMFS 2007 BO identified three exposure mechanisms from herbicide due to 1) runoff from riparian application, 2) application within perennial streams (i.e. emergent invasive plants), and 3) runoff from treated [roadside] ditches and dry intermittent streams.

Drift is the most likely vector for herbicides coming in contact with water from riparian area or emergent vegetation treatment sites. The potential for drift varies with the herbicide application method. Spot and hand application methods substantially reduce the potential for herbicide contact with water because there is little potential for drift. Drift is mainly associated with broadcast treatments. Potential for drift can be mitigated to some extent by the applicator (see section 3.2 for more information about drift).

All of the alternatives apply a high degree of caution to herbicide use (for details on the layers of caution see Chapter 2: tables 12, 13, 14 and 16, and Chapter 3: tables 29 and 30 and figure 2). The types of application methods proposed (mainly spot and hand treatment and limited roadside broadcasting) have low potential to harm beneficial uses of water. The closer to water the treatments are, the more limited the choice of specific herbicide ingredients and the manner that they may be applied. Label restrictions; restrictions on application rate, type of herbicide, and application method; buffers; and the use of adjuvants all factor in to limiting the potential amount of drift. In addition, roads that have a high potential for herbicide delivery have been identified and have added restrictions, such as no broadcasting. Although there will be no herbicide applied directly to the water column for purposes of treating submerged vegetation, there may be some fine droplets from spot applications coming in contact with water as a result of treating emergent vegetation.

Herbicide can move from the treatment location into adjacent areas through runoff. Some runoff can enter streams either through road or slope drainage. Roadside ditches can act as herbicide delivery routes to streams during high rainfalls or as settling ponds following rainfall events.

Previous Herbicide Run-Off Monitoring Results

Berg (2004) compiled monitoring results for broadcast herbicide treatments given various buffers along waterbodies. The results showed that any buffer helps lower the concentration of herbicide in streams adjacent to treatment areas. In California, when buffers between 25 and 200 feet were used, herbicides were not detected in monitored streams (detection limits of 1to 3 mg/m3) (ibid).

In South Carolina, buffers of 30 meters (comparable to 100 feet) during ground applications of the herbicides imazapyr, picloram and triclopyr resulted in no detectable concentrations of herbicide in monitored streams (ibid). No detection limits were given.

Even smaller buffers have successfully protected water quality. For example, where imazapyr was aerial sprayed without a buffer, the stream concentration was 680 mg/ml. With a 15-meter buffer, the concentration was below detectable limits (ibid.). No detection limits were given.

Berg also reported that herbicide applied in or along dry ephemeral or intermittent stream channels may enter streams through run-off if a large post-treatment rainstorm occurred soon after treatment. This risk is minimized if intermittent and ephemeral channels are buffered (ibid.). Risk may also be minimized by limitations on herbicide selection and application method.

If a large rainstorm occurs sediment contaminated by herbicide could be carried into streams. As most ditch lines on the National Forest are heavily vegetated, this is less likely to occur than in a drier environment.

The United States Geological Service, in partnership with the Oregon Department of Transportation, studied runoff of herbicides along roads (Wood, 2001). The study was conducted on runoff associated with sulfometuron methyl and glyphosate along a road in western Oregon. Water (simulated rainfall) was applied at 1/3 inches an hour at 1, 7 and 14 days after treatment. Samples were collected at the shoulder of the road and found concentrations of several hundred ppb of sulfometuron-methyl and nearly 1,000 ppb of glyphosate that could potentially leave the road shoulder.

In the fall, the road was again sprayed and the ditch line of the road was checked during natural rainstorms for three months. Sulfometuron-methyl was found in concentrations of 0.1 to 1 parts per billion (ppb) along the shoulder and from 0.3 to 0.1 ppb in the ditch line, but below detectable limits in the stream. Glyphosate was not found at the shoulder, ditch line or stream.

Results from the simulated rainfall experiment suggested that a heavy rainstorm occurring soon after application could generate concentrations in the runoff leaving the road shoulder of nearly 1 mg/L glyphosate (above level of concern for fish = 0.5 mg/L), and concentrations on the order of a few hundred micrograms per liter of sulfometuron-methyl (ibid). The concentration in the direct runoff from the road should provides an upper limit for the mixing waters that converge in the roadside ditch from the entire drainage, but probably overestimates the concentration in the ditch itself (ibid).

The road shoulder was again sprayed with sulfometuron-methyl and glyphosate at the end of September during natural rainfall conditions, in order to measure the loadings of the compounds to Bull Creek, a small tributary in the Willamette Valley, from the drainage ditch under realistic conditions. Sulfometuron-methyl was detected up to 0.001 mg/L in the runoff from the road shoulder throughout a 3-month sampling period, and in the drainage ditch decreased from 0.001 mg/L in October and November to about 0.0003 mg/L in January (ibid). Sulfometuron-methyl was never detected in Bull Creek, and mass balance calculations confirmed that the load of this compound to Bull Creek from the drainage ditch would not have resulted in detectable concentrations in the stream.

Glyphosate was never detected in any of the fall samples from the road shoulder, the drainage ditch, or the stream. This is an important finding because of the concern surrounding the potential for glyphosate to be delivered at amounts that impact critical habitat for fish from roadside treatments on National Forest System lands. Herbicide concentrations from the simulated rainfall experiments and the stream and ditch discharges measured during natural rainfall indicated that in Bull Creek, a small stream with a fall and winter discharge between 10 and 20 cfs (cubic feet per second) ODOT operations could, conceivably, result in herbicide concentrations on the order of 0.001 mg/L (ibid), which is far below levels of concern for aquatic organisms. This would require a heavy rainfall immediately after application, a situation that certified and trained herbicide applicators avoid and is not routine.

Results from this study are representative of a rural setting with relatively little impervious area, well-drained soils, and an unpaved drainage system to deliver runoff from the road and shoulder to a receiving stream. Based on the results of this study, it appears that sulfometuron-methyl may persist in the environment as it was detected in the runoff from the shoulder, and in the drainage ditch. However, sulfometuron-methyl was never detected in Bull Creek and it is believed that loadings from the drainage ditch would not have resulted in detectable concentrations in the stream.

The amounts detected under natural rainfall conditions were well below levels of concern for aquatic organisms. Because the total area that proposed for treatment is a small fraction of any given drainage basin, and the implementation of specific PDC for roads with high potential for herbicide delivery, the potential for herbicide concentrations in all but the most undiluted roadside drainage ditches would likely be immeasurable. In addition, this study represents a worst case scenario that is rarely seen along road systems on National Forest System lands.

In the event of a rainstorm, there is a large component of overland flow from the road surface, rather than percolation and subsurface flow. So there is more water delivered to the edge of the ditch area into a vegetated segment that has been treated, thus further diluting herbicides in the ditch than the Wood (2001) study indicates. The resulting herbicide concentration in the ditch as a result of instantaneous runoff cannot be the same as the concentration in a connecting stream because of dilution, entrainment of herbicide into sediment, and breakdown properties. The Wood (2001) study indicated that runoff from ditches into a stream made up at most, 17 percent of the stream flow. Thus, there would be significant dilution compared to the study results.

The Washington State Department of Agriculture (WSDOA 2004, 2005 and 2006) monitored residual concentrations of aquatic labeled herbicides for treatment of emergent noxious and quarantine weeds. Ten out of the sixteen sites sampled between the years 2003 and 2005 showed residual herbicide levels that were below a level of concern for drinking water. The rest showed no detectable level of herbicide.

Roadside Ditches

Herbicide may be used in or along roadside ditches in some alternatives. Known treatments within ditchlines are small and scattered across large road and stream networks. The potential for herbicide to collect in ditches and enter streams in concentrations of concern is low due to the low number of treatment acres proposed in any watershed.

The primary determinants of exposure include herbicide properties, application rate, extent of application, application timing, and precipitation amount and timing, and proximity to stream crossings. The highest concentrations of herbicides resulting from application to ditches and intermittent channels are likely to occur early in storm runoff. The most significant exposure locations are at or near confluences with perennial streams (NMFS BO 2007).

Accidental Spill

Concentrations of herbicides in the water as a result of an accidental spill depend on the rate of application and the stream's ratio of surface area to volume. The persistence of the herbicide in water depends on the length of stream where the accidental spill took place, velocity of stream flow, and hydrologic characteristics of the stream channel. The concentration of herbicides would decrease rapidly down-stream because of dilution and interactions with physical and biological properties of the stream system (Norris et al.1991).

Project design features would reduce the potential for spills to occur, and if an accident were to occur, minimizes the magnitude and intensity of impacts. An herbicide transportation and handling plan (See Table 12, PDF G) is a project requirement. This plan would address spill prevention and containment. Extensive monitoring of herbicide application using similar treatment methods has occurred over the last few years in northwest Oregon and western Washington. All personnel applying the herbicides are well trained and licensed. No accidental spills have been reported.

Municipal Watersheds and Domestic Water Supplies

Coordination with water boards and users would occur, and herbicide use within 1000 feet upstream (slope distance) of known water intakes would be coordinated with the water manager or owner. In all alternatives, existing municipal watershed agreements would be followed.

Most of the infestations in municipal watersheds are along roads. Some of these roads are currently proposed for broadcast treatment, assuming density of invasive plants warrant this method. Herbicide use may be excluded or limited to spot and/or hand treatments according to memoranda of understanding.

All alternatives comply with the Olympic National Forest Standard related to using herbicides only as a last resort and only when water quality will not be adversely affected, because:

- Herbicides are proposed for target species that cannot be effectively controlled using other methods.
- All alternatives protect drinking water supplies. There are no plausible scenarios that could lead to drinking water contamination sufficient to affect public health, given the types of herbicide proposed and the manner they will be used. Concentrations of herbicides that may reach groundwater or streams are low and below levels of concern for people.
- Approximately 210 acres are proposed for treatment within municipal watersheds, about half of which are estimated to be within the Aquatic Influence Zone. This is a very small scale of herbicide use in relation to the size of the municipal watersheds. One small infestation lies within 1000 feet of the Lake Southerland Water District intake; otherwise all infestations are more than 1000 feet from intakes).

Aquatic Conservation Strategy

Treatment of invasive plants is consistent with recommendations in watershed analysis done for key watersheds on the Olympic National Forest. Invasive plant treatments in the scope of this document are not likely to retard achievement of ACS objectives because the scale of treatment is small and the potential for harm is low:

- Less than one percent of the National Forest System lands across all watersheds is currently infested.
- Less than six percent of National Forest Service System lands within any single 6th field watershed are currently infested. These infestations cover less than three percent of any single 6th field watershed when other ownership acreage is added.

Alternative D is associated with the greatest risk of herbicide delivery to streams (see alternative comparison below). Broadcast treatments along intermittent streams and roadside ditches in Alternative D would have the potential to deliver herbicides to streams and other water bodies, which could retard achievement of ACS objectives.

An analysis of each alternative relative to ACS objectives is in the following section.

Alternative Effects Comparison

Alternative A (No Action)

Direct and Indirect Effects

Under the No Action alternative, manual and mechanical treatments would occur on about 672 acres (in combination with herbicides on 86 of these acres). The herbicides currently available for use under this alternative are glyphosate, picloram and dicamba. The primary non-herbicide treatments would be hand pulling and mowing.

Effects to soils from invasive plant treatments could result in small areas of localized erosion and sedimentation. These effects would be minimal given the small amount of land treated, especially within Aquatic Influence Zones, and the scattered nature of the treatments. These effects would last one season until vegetation became re-established.

The treatments proposed are unlikely to result in significant amounts of decaying plants or nutrients entering a stream at one time, and therefore no measurable effect to oxygen levels is anticipated. Most invasive plants provide little shade; therefore removing them would not lead to a measurable change in temperature. Knotweeds and other invasive plants would continue to destabilize stream banks.

Measurable chemical contamination is unlikely. No effect to stream flows is expected under this alternative. The acreage that would be treated using herbicide along road segments with high risk of herbicide delivery to surface waters is estimated to be less than 40 acres.

Cumulative Effects

The spatial scale for cumulative effects analysis for soils and water is the 6th field watershed level. This scale was chosen because it allows for consideration of whether herbicide use in all alternatives, when added to other actions in the watershed, result in adverse effects beyond those disclosed in the direct and indirect effects analysis. Some of the watersheds are primarily Forest Service land and others are mostly private land. National Forest System lands cover about 35 percent of the average 6th field watershed in the project area.

Land management activities, including treatment of invasive plants, would continue to occur on other ownerships within 6th field watersheds. Counties commonly treat roadsides with herbicide and non-herbicide methods. Herbicides are also used on private farmland, golf courses, and private timberlands. The extent and type of herbicide use on private lands was estimated in Chapter 4.1 of the R6 2005 FEIS.

None of the streams in the project area are currently 303(d) listed for chemical contamination. The No Action Alternative would not contribute to chemical contamination due to the low use of herbicides near water or along higher risk roadsides. The minor amount of sediment associated with treatments under No Action is very low and would be negligible at the watershed scale, due to the limited acreage treated and the low impacts of these treatments at any one site.

Aquatic Conservation Objectives

The following discussion is focused on the existing condition relative to invasive plants in the treatment area and their impact on meeting ACS objectives. The No Action Alternative assumes ongoing treatment; however, the effects of treatments approved under No Action are minor, short-lived and insignificant relative to ACS objectives.

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

The diversity of watershed scale features may be impacted over time by the spread of invasive plants. Invasive plants found growing adjacent to or within aquatic influence areas can invade, occupy, and dominate riparian areas and indirectly impact aquatic ecosystems and fish habitat. About 33 percent of the currently infested sites are found within Riparian Reserves. About 70 percent of the invasive plant sites are within Key Watersheds.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

No action would not affect chemical or physical routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species, at any scale. Small obstructions are possible from emergent target species (reed canary grass, knotweed, purple loosestrife). B*lackberries established along streambanks may result in roots aggrading the channel and blocking fish access during low flow.*

Some invasive plant treatments can have positive effects on floodplains and streambanks when infestations of invasive plants on valley bottom areas are removed. Valley-bottom infestations often encroach floodplains where road-related and recreational activities have led to the establishment of invasive plant populations. Removal of such infestations is expected to benefit aquatic and terrestrial communities in the long term by increasing floodplain area available for nutrient, sediment and large wood storage, and flood flow refugia.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

Approximately 12.5 acres of Japanese knotweed and 0.2 acres of giant knotweed are estimated within treatment areas on the Olympic National Forest. Japanese knotweed has poor bank holding capacity, which can result in bank erosion and sedimentation of streams in high winter flows.

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

Invasive plants do not currently affect water quality. The range and extent of target species in aquatic influence zones is relatively small (about 600 acres across the Forest as a whole, no more than 70 acres in any one 6th field watershed). No streams on the Forest are water quality listed (303d) for chemical contamination.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Target species such as knotweed, blackberry, purple loosestrife and reed canarygrass can choke streams, become sediment traps and cause stream aggradation, and block fish access. Spawning gravels locked up in the root masses are unavailable for fish, and the stream areas around the root masses have such accelerated flows that gravels are not retained, resulting in a net loss of fish habitat. Banks could become less stable, leading to changes in suspended sediment and substrate character and embeddedness. Potentially this could lead to changes in pool frequency and quality.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

Invasive plants can change stand structure and alter future inputs of wood and leaves that provide the basic foundation of the aquatic ecosystem food webs. Hydrologic changes from invasive plant treatments would never be large enough to cause effects at a subwatershed scale. There is no risk of increasing water yield at any scale as a result of treating invasive plants.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Reed canary grass, purple loosestrife, or knotweed emerging from wetlands can alter water table elevation.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

Riparian vegetation stabilizes stream banks, and acts as a filter to prevent the run-off of soil into streams. Riparian vegetation also provides large and small wood to streams, adding to habitat complexity and providing cover and food sourced for aquatic organisms. Aquatic ecosystems have evolved with certain vegetation types; invasive plants do not necessarily provide similar habitat.

While knotweed may provide shade, native streamside hardwoods and conifers are much taller, so knotweed dominated areas may be associated with higher water temperatures than areas with native forest communities.

Approximately 156 acres of reed canary grass are mapped along streams and wetlands on the Forest. Reed canarygrass is extremely aggressive and often forms persistent, monocultures in wetlands and riparian areas.

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

Native vegetation growth may change as a result of infestation, and the type and quality of litter fall, and quality of organic matter may decline, which can alter or degrade habitat for aquatic organisms. For example, native vegetation regeneration was reduced as a result of knotweed infestations (Urgenson personal communication). The amount of nitrogen to aquatic ecosystems through riparian litter fall may be compromised because knotweed retains more nitrogen than native species. The availability of nitrogen to aquatic biota and native vegetation may be significantly reduced because knotweed can uptake or hold on to 75 percent of leaf nitrogen in the root system (ibid). Primary and secondary consumers that form the basic food source for fish and other aquatic organisms may be indirectly affected. Reed canarygrass infestations threaten the diversity of these areas, since the plant chokes out native plants and grows too densely to provide adequate cover for small mammals and waterfowl.

Alternative B

Direct and Indirect Effects

Under Alternative B, all 3,830 infested acres would be treated using herbicides, manual, and mechanical methods. Herbicides would be a part of the prescription on most acreage, particularly the first few years of treatment. The proposed use of herbicides combined with manual and mechanical methods reduces the potential for significant soil disturbance as compared to manual and mechanical methods alone.

A minor localized increase in fine sediments could result from invasive plant removal along streams, particularly if vegetation is removed from stream banks. These effects would be temporary (one season or shorter) until vegetation became re-established. Active restoration is proposed on approximately 65 percent of the sites to ensure revegetation occurs and erosion is controlled. Forest BMPS, standards and guidelines, and herbicide use buffers would be followed to ensure that water resources were protected.

Broadcast application of herbicides has more potential than other application methods to contact soil and affect soil organisms and/or productivity. Broadcast treatments are also associated with a risk of leaving large areas of soil bare. Mulching, seeding, and planting would occur as described in the restoration plan, which would reduce the risk of erosion or other adverse soil conditions in bare areas.

In Alternative B, no broadcast treatment would occur on roads having a high potential for herbicide delivery (see list and map in Appendix D – this covers 66 percent of the roadside treatment areas). Broadcast application would be allowed only on the remaining 34 percent of the treatment areas. No picloram would be used on roads having a high potential for herbicide delivery (not even with hand or spot treatments). Broadcast treatments within aquatic influence zones would be limited to herbicides posing low levels of concern for aquatic organisms. Herbicides considered high risk to aquatic organisms would not be applied using any method within 15 feet of ditches that feed streams, or 50 to 100 feet from intermittent streams, even when ditches or intermittent streams are dry. These buffers are considered adequate to minimize herbicide concentrations in water because, buffer studies in forested areas (Berg, 2004) show that [broadcast] buffers greater than 25 feet commonly lower herbicide concentrations below detectable limits. Spot and hand treatments require smaller buffers because the potential for off site movement using these methods is much less than with broadcasting.

This project takes into account the delivery mechanism of road side ditches, something most projects do not take in to account. By applying buffers for broadcast treatments to the ditches with high potential to deliver herbicides through the ditchline to streams, and eliminating the use of herbicides considered high risk to aquatic organisms, adverse effects from treating these areas is minimized.

Given the buffers for broadcast applications on both perennial and intermittent streams, if rain occurred soon after application, herbicide would be filtered before entering the water. Spot and hand treatments use small amounts of herbicide and sites are scattered; therefore, even if a large rain event occurs soon after treatment, it is unlikely that substantial amounts of herbicide would enter water bodies.

The PDFs were developed considering herbicide and soil properties and are expected to control movement of herbicides off-site. Treatments would occur during times of the year when soils are driest. If herbicide treatment is necessary when soils are wet, aquatic-labeled herbicides or those that pose low risk to aquatic organisms would be used according to label directions.

Most of the herbicides used under this alternative do not negatively affect soil organisms at typical application rates. Of the ten herbicides available for use, two (picloram and sulfometuron methyl) have the potential to affect soil organisms at typical application rates. These herbicides have half-lives of 90 days and 10-100 days depending on soil conditions. Soil productivity is protected by the PDFs that restrict the amount of these two herbicides and the frequency of application. Thus, at any one site, herbicides would be degraded before more would be used, and no cumulative chemical loading would occur in the soil. Therefore, cumulative impacts to soil productivity would be avoided in all situations.

PDFs also minimize the chance of herbicides reaching streams or wetlands. Buffer widths vary depending on herbicide ingredients and application method. Wetlands would be treated using non-herbicide methods where such treatments are likely to be effective. Non-herbicide treatments are not effective for treating knotweed; therefore, some hand application of herbicide would occur in or near stream channels. Where invasive plants are emergent from water, herbicide would be applied through hand and selective methods. Effective treatment of knotweed and replacement with native vegetation would lead to increased bank and channel stability in these sites.

Effects of Riparian Treatment at the Site Scale

The potential for run off to result in herbicide contamination to water (associated with treatments within Riparian Reserves) was analyzed at the site scale using the SERA Worksheets (SERA 2007). The worksheet model is sensitive to the behavior of each herbicide in soil and water. Potential concentrations from emergent vegetation treatments were also calculated (see Chapter 3.5 below for more information). The model and calculation were used to indicate whether treatments near streams and wetlands could enter water in concentrations above a level of concern for beneficial uses, including drinking water and fish. More information on the methodology used is in SERA 2007, the Biological Assessment for this project (available on our website or hard copy by request), and Chapter 3.5 below.

Cranberry Bog Botanical Area and the Middle Hoh River treatment areas have the greatest likelihood of herbicides coming in contact with water as a result of treatment of emergent wetland vegetation. The worst-case analysis indicated a relatively low risk of adverse effects from herbicide delivery at the site scale. While some herbicide is predicted to contact water at these sites despite cautious practices, the amount would be much smaller than the amount that could cause concern to water quality, watershed processes or aquatic organisms. In the analysis, all invasive plants within these treatment areas were assumed to lie near or within a stream, floodplain or wetland. In reality, treatment areas contain upland and riparian target species.

The PDFs, buffers and Implementation Planning process ensures that potential for harm to the aquatic ecosystem remains low for future treatments under the Early Detection Rapid Response approach (see Chapter 2.5). No more than 6 acres of aquatic emergent invasive vegetation would be treated annually per 6th field watershed.

Delivery to Streams via Roadside Ditches

The PDFs and buffers under Alternative B minimize the potential for herbicide to be delivered to streams via roadside ditches. No broadcast of herbicide would occur on any roadside with high potential to deliver herbicide to streams. Buffers eliminate broadcast treatments and use of certain herbicides where roads cross wet or dry streams and/or wetlands (see Chapter 2.5). The distribution of invasive plant infestations in ditches is patchy and there are not likely to be treatments of large, contiguous areas. High application rates would be avoided in Aquatic Influence Zones, except where necessary to effectively treat target species using selective methods such as stem injection.

Early Detection-Rapid Response

The PDFs limit the extent of treatment annually within riparian areas and aquatic influence zones, and along roads with high potential to deliver herbicide to streams. The PDFs ensure that effects are the same whether new or existing infestations are being treated. No adverse cumulative effects are expected from implementation of this alternative due to these limitations regardless of the location of future treatments.

Cumulative Effects

Buffering waterbodies lowers the potential for herbicide to enter water. While some herbicide delivery to water is possible, the amount of herbicide would not exceed any threshold of concern relative to water quality and beneficial uses. The herbicides selected for use under this alternative minimize adverse effects while still giving a range of treatment options.

Less than one percent of the National Forest System land in the project area is proposed for treatment. No more than 5 percent of the National Forest System lands allocated to riparian reserves in any 6th field watershed is proposed to be treated, and in most cases is far less. This small scale of treatment compared with the watershed size is one reason that effects to water quality are unlikely.

The following ten 6th-field watersheds currently contain at least ten acres of estimated treatment within the Aquatic Influence Zones in the upper 70 percent of the watershed. The upper 70 percent is the portion of the watershed most likely to contain small, high elevation streams.

South Fork Calawah River: Approximately 74 infested acres are estimated to lie within Aquatic Influence Zones in the upper 70 percent of the watershed. These acres are not concentrated within a single part of the watershed. Many of the roads in this watershed are associated with high risk for delivery of herbicide to streams.

Upper West Fork Satsop River Watershed: About 33 infested acres are estimated to lie within Aquatic Influence Zones in the upper 70 percent of the watershed. A road with high potential to deliver herbicide parallels Spoon Creek. The treatments are all high in the watershed where the streams tend to be smaller with less flow but are not concentrated within a single part of the watershed.

West Fork Humptulips River Watershed: Approximately 34 acres are estimated to lie within Aquatic Influence Zones in the upper 70 percent of the watershed. Many of the treatment areas are along roads that follow the West Fork Humptulips River or are tributaries to the river. The river is much larger than the stream simulated in the GLEAMS modeling.

East Fork Humptulips River Watershed: The treatments are a combination of roads and plantations. Many of the roads parallel the River or tributary streams. About 24 acres are estimated to lie within Aquatic Influence Zones in the upper 70 percent of the watershed. These acres are not concentrated within a single part of the watershed. Many of the roads in this watershed are associated with high risk for delivery of herbicide to streams.

Quinault Lake: Most of the treatment areas are on roads, developed areas of summer homes and campgrounds. Approximately 31 acres are estimated to lie within Aquatic Influence Zones in the upper 70 percent of the watershed. Few of the roads in this area are considered high risk for delivery of herbicide to streams.

Jefferson Creek Watershed: Approximately 16 acres are estimated to lie within Aquatic Influence Zones in the upper 70 percent of the watershed. The treatments are along roads that parallel both Jefferson and Washington Creeks. The treatments areas are not concentrated in one area of the watershed and the river is much larger than the stream simulated in the GLEAMS modeling.

Middle Sol Duc River Watershed: Approximately 17 treatment acres are estimated to lie within Aquatic Influence Zones in the upper 70 percent of the watershed. The treatments are scattered across the watershed along Bear Beaver and Cold Creeks. They are primarily along roads but include other disturbed areas including part of the Saddle/Bear planned timber sale.

Upper South Fork Skokomish River: Approximately 15 acres are estimated to lie within Aquatic Influence Zones in the upper 70 percent of the watershed. These treatments are primarily along the South Fork Skokomish River, Brown Creek, Pine Creek, Cedar Creek and Lebar Creek. The intermittent streams within project areas in this watershed feed into many different perennial streams and are not concentrated in any part of the watershed.

Main Stem Hamma Hamma River Watershed: The treatments parallel the river for over seven miles and also follow Boulder Creek. The roads are high risk for delivery of herbicide to the streams.

Approximately 13 acres are estimated to lie within Aquatic Influence Zones in the upper 70 percent of the watershed and are scattered along miles of treatment areas.

North Fork Calawah River Watershed: Approximately 24 acres are estimated to lie within Aquatic Influence Zones in the upper 70 percent of the watershed. The roads in this watershed are at high risk for delivery of herbicide to streams. These acres are not concentrated within a single part of the watershed.

In all of these 6th field watersheds, treatments are small and scattered. Treatments are unlikely to affect functioning of wetlands or water bodies, and there is no risk of retarding achievement of Aquatic Conservation Strategy (ACS) objectives because of the limited extent and range of treatments allowed in aquatic influence zones. The PDFs limit the amount of treatment that could occur annually in aquatic influence zones (PDFs H13 and H14) so that future treatments under EDRR do not result in greater potential effects. In all action alternatives, no more than 6 acres of aquatic emergent vegetation would be treated in any 6th field watershed, nor would more than 10 riparian acres per 1.5 miles of stream be treated in any given year.

PDFs were developed considering watershed conditions. The PDFs ensure that treatments would not adversely affect watershed quality or function, even if invasive plants were to spread further into aquatic influence zones in these or other watersheds, or further along roads with high potential to deliver herbicide to surface waters.

The primary indirect, adverse effects resulting from the proposed action are expected to be of varying duration (weeks to years). Degraded water quality from herbicide applications, reflected by primary and secondary productivity loss, 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 (NMFS 2007 BO).

Aquatic Conservation Objectives

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

Alternative B would restore the diversity of watershed scale features by removing invasive plants found growing adjacent to or within aquatic influence areas. Invasive plant treatment under Alternative B would follow recommendations in watershed analysis.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

Alternative B would not likely affect chemical or physical routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species. The amount of treatment in any given watershed is small. Less than six percent of National Forest Service system lands within any single 6th field watershed are currently infested. These infestations cover less than three percent of any single 6th field watershed.

The routes for herbicide to contaminate water are treatments of emergent vegetation and potential runoff from a large rain storm soon after application, especially from treated roadside ditches. Treatment of emergent vegetation is not intended to be a direct application of herbicide to water. However, treatment of emergent vegetation may result in some minor drift to surface waters (particularly at the Cranberry Bog Botanical area and Middle Hoh River Floodplain site). Previous monitoring efforts from the State of Washington have not detected exceedance of State drinking water standards for spot treatment of emergent vegetation. Concentrations of herbicide that could reach streams from these treatments would be far below levels of concern.

Invasive plant treatments will not create physical barriers or otherwise degrade access to aquatic habitat.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

Alternative B would restore the physical integrity of shorelines and streambanks by replacing invasive plants with native plant communities. The types of treatments proposed could result in minor streambank erosion, but since no heavy equipment would be used, impacts would be localized and short-lived. There is no risk of negatively impacting channel condition and dynamics as a result of treating invasive plants.

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

The extent and range of infestations currently found in aquatic influence zones is relatively small (about 600 acres over the National Forest as a whole, no more than 74 acres in any 6th field watershed). No more than ten acres would be treated within any 1.5 miles of stream. The amount of treatment that could occur annually in aquatic influence zones is limited by PDFs H14 and H15, so that future treatments under EDRR would not result in greater potential effects. Some herbicide may enter water bodies, but not in quantities sufficient to reduce water quality at any scale.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Treatment of invasive plants has a low probability for producing sediment because very little ground disturbance will take place when invasive plants are treated with spot-spray or hand applications. Manual, mechanical, and restoration treatments are extremely unlikely to contribute sediment. The integration of manual/mechanical/herbicide treatments would limit the potential for excessive trampling and not solely rely on manual labor. Manual labor such as hand pulling and the use of mechanical equipment to control invasive plants may result in localized soil disturbance, but increases of sediment to streams would likely be undetectable. Not all vegetation in a treated area would be pulled or removed, so some ground cover plants would remain. Not all sediment from pulling weeds along roads or use of mechanical equipment to cut weeds would reach a stream because many relief culverts intercept ditch flow and drain it on to the forest floor away from streams. Handpulling is very labor intensive and costly. Thus, few acres per year could be treated using this technique across a watershed. The amount of sediment created by manual, mechanical, and restoration treatments is anticipated to be insignificant because the methods of treatments do not include ground disturbing activities by heavy equipment. When compared to the total acres within a watershed, project-related soil disturbance from handpulling would be negligible.

Removal of invasive plants and replacement with native plant communities would restore sediment regime affected by knotweed and other target species. Projects may result in small amounts of sediment, especially related to manual and mechanical treatments, but the limited overall extent would not result in watershed-scale impacts. No heavy equipment would be used off roads in riparian reserves.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

Removal of invasive plants and replacement with native plant communities would restore future inputs of wood and leaves that provide the basic foundation of the aquatic ecosystem food webs. Treatment of invasive plants in riparian reserves would not impact current wood debris in streams. The PDF that establishes a 100 ft buffer for broadcast applications provides protection to the recruitment of conifer seedlings within riparian areas which will sustain channel and habitat features in the future. With the treatment of invasive plants, riparian stands in time would develop larger recruitment trees and would increase the size of inchannel debris.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Removal of invasive plants and replacement with native plant communities would restore floodplain habitat and water table elevation in meadows and wetlands. The Hoh River Floodplain was analyzed for a worst-case scenario involving herbicide use. Results indicated a low level of risk from proposed treatments (see Chapter 3.5 of the FEIS).

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

Removal of invasive plants and replacement with native plant communities would restore species composition and structural diversity in riparian areas and wetlands. Herbicide application near streams may result in some minor non-target vegetation impacts at the site scale; however, the amount of herbicide that could contact streams would not be enough to species or structural diversity.

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

Removal of invasive plants and replacement with native plant communities would restore habitat for species dependant on riparian and aquatic habitats. The use of spot-spray applications of aquatic glyphosate and aquatic imazapyr near wet streams may result in some minor non-target vegetation impacts at the site scale. However, the amount necessary to affect to affect habitat for populations of plants, invertebrates and vertebrates in riparian areas is not possible with spot-spray applications.

Alternative C

Direct and Indirect Effects

This alternative includes no broadcast application of herbicides and no herbicide use in Riparian Reserves or along any road having a high potential to deliver herbicide (see Appendix D for a map and list of these roads). About 1,025 acres would be treated with herbicides, all outside of aquatic influence zones. Thus, there would also little risk of runoff carrying herbicide to streams.

Alternative C has the greatest potential for erosion and sediment delivery to streams due to reliance on non-herbicide methods in riparian reserves and along many of the roads across the Forest. Alternative C increases the risk of trampling and instability of stream banks due to its reliance on non-herbicide treatments, particularly in areas where Scotch broom or other invasives grows directly along stream banks. The greatest likelihood of measurable erosion within the scope of any alternative is associated with weed wrenching scotch broom without accompanying herbicide use.

About half of the scotch broom acreage to be treated under the current inventory is along roads identified as having a risk of herbicide delivery to streams and may be within Riparian Reserves. Herbicide use would be excluded in these areas, thus there would be increased risk of erosion from non-herbicide methods. Ironically, these are the areas where erosion could lead to stream sedimentation. However, treatment sites are currently small and scattered across the Forest, so the likelihood of significant adverse impacts is remote. Effects would be minor, localized and short-term effect and passive and or active revegetation would occur.

Invasive plants provide little shade therefore removing them would not lead to a measurable change in temperature. The treatments proposed are unlikely to result in significant amounts of decaying plants or nutrients entering a stream at one time and therefore no measurable effect to oxygen levels is anticipated. In the long-term temperature would be improved on streams currently impacted by invasive plants because native, shade-producing vegetation could be restored.

Effects of Riparian Treatment at the Site Scale

No herbicide would be used in any riparian area, so there would be no potential for SERA predicted results to actually occur.

Delivery to Streams via Roadside Ditches

Alternative C virtually eliminates risk of herbicide delivery to streams from roadside ditches by prohibiting herbicide use on high risk road segments or in Riparian Reserves.

Early Detection-Rapid Response

Future treatments under EDRR would follow the PDFs for Alternative C. Thus, the potential for herbicide delivery to streams would be very low regardless of the extent or location of treatment under EDRR. Non-herbicide treatment in aquatic influence zones and along certain roads could result in increased erosion, depending on the location and extent of treatment.

Cumulative Effects

The cumulative effects of Alternative C are similar to Alternative A within Aquatic Influence Zones and roadside treatment areas that have a high risk of delivering herbicide to streams. The cumulative effects of Alternative C are similar to Alternative B outside these areas.

Aquatic Conservation Objectives

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

Alternative C would restore he diversity of watershed scale features by removing invasive plants found growing adjacent to or within aquatic influence areas. Invasive plant treatment under Alternative C would follow recommendations in watershed analysis. Alternative C is less cost-effective than Alternative B in restoring native plant communities so it would take longer and cost more to restore desired conditions.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

Alternative C would not likely affect chemical or physical routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species. The amount of treatment in any given watershed is small. Less than six percent of National Forest System lands within any single 6th field watershed are currently infested. These infestations cover less than three percent of any single 6th field watershed when other ownership acreage is added.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

Alternative C would restore the physical integrity of shorelines and streambanks by replacing invasive plants with native plant communities. The types of treatments proposed could result in minor streambank erosion, but since no heavy equipment would be used, impacts would be localized and short-lived. Alternative C is less cost-effective than Alternative B in restoring native plant communities so it would take longer and cost more to restore desired conditions. In addition, because no herbicide would be used on shorelines or streambanks, greater reliance on manual and mechanical treatments could lead to increased erosion compared to Alternative B.

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

The extent and range of infestations currently found in aquatic influence zones is relatively small (about 600 acres over the National Forest as a whole, no more than 74 acres in any 6th field watershed). No more than ten acres would be treated within any 1.5 miles of stream. The amount of treatment that could occur annually in aquatic influence zones is limited by PDFs H13 and H14, so that future treatments under EDRR would not result in greater potential effects. No herbicide would enter water bodies so no chemical contamination would be possible.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Removal of invasive plants and replacement with native plant communities would restore sediment regime affected by knotweed and other target species. Projects may result in small amounts of sediment, especially related to manual and mechanical treatments, but the limited overall extent would not result in watershed-scale impacts. No heavy equipment would be used off roads in riparian reserves. Alternative C is less cost-effective than Alternative B in restoring native plant communities so it would take longer and cost more to restore desired conditions. In addition, because no herbicide would be used on shorelines or streambanks, greater reliance on manual and mechanical treatments could lead to increased erosion compared to Alternative B.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

Removal of invasive plants and replacement with native plant communities would restore future inputs of wood and leaves that provide the basic foundation of the aquatic ecosystem food webs. Alternative C is less cost-effective than Alternative B in restoring native plant communities so it would take longer and cost more to restore desired conditions.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Removal of invasive plants and replacement with native plant communities would restore floodplain habitat and water table elevation in meadows and wetlands. Alternative C is less cost-effective than Alternative B in restoring native plant communities so it would take longer and cost more to restore desired conditions.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

Removal of invasive plants and replacement with native plant communities would restore species composition and structural diversity in riparian areas and wetlands. Alternative C is less cost-effective than Alternative B in restoring native plant communities so it would take longer and cost more to restore desired conditions.

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

Removal of invasive plants and replacement with native plant communities would restore habitat for species dependant on riparian and aquatic habitats. Alternative C is less cost-effective than Alternative B in restoring native plant communities so it would take longer and cost more to restore desired conditions.

Alternative D

Direct and Indirect Effects

Alternative D allows broadcast of herbicide along roadsides with high potential to deliver herbicide to streams. It also does not require buffers where roads cross dry streams. Therefore, Alternative D has the greatest risk of herbicide delivery to surface waters. It increases risk compared to the Proposed Action because buffers for dry streams (Table 14 and PDF H3 (Table 12) regarding roads having high potential for herbicide delivery would not be applied. All other PDFs for perennial streams, municipal watersheds, wetlands, ponds and lakes would be applied.

Aquatic emergent treatments and treatments near streams would have similar aquatic use restrictions as to Alternative B. Thus, Alternative D would not necessarily meet all Forest Plan Standards for Riparian Reserves.

To meet the standards, either broadcast treatments would need to be eliminated in these areas, or herbicides selected for broadcasting would have to be among those of lower risk to aquatic organisms (see Aquatic Organism section 3.5), or additional monitoring would have to occur to ensure that herbicides do not enter water in concentrations of concern relative to aquatic organisms.

Effects of Riparian Treatment at the Site Scale

The potential for run off to result in herbicide contamination to water (associated with treatments within Riparian Reserves) was analyzed at the site scale using the SERA Worksheets (SERA 2007). The analysis for Alternative B also applies to Alternative D relative to treatments near wet streams, lakes and wetlands. As in Alternative B, the PDFs, buffers and Implementation Planning process ensure that potential for harm to the aquatic ecosystem remains low for future treatments under the Early Detection Rapid Response approach (see Chapter 2.5).

Delivery to Streams via Roadside Ditches

Alternative D allows broadcast of herbicide along roadsides with high potential to deliver herbicide to streams. It also does not require buffers where roads cross dry streams. Thus, potential for herbicides to be delivered to streams in concentrations of concern via roadside ditches and dry streams is highest for Alternative D than the other alternatives. The distribution of invasive plant infestations in ditches is patchy and there are not likely to be treatment of large, contiguous areas. Use of maximum herbicide application rates would be rare and only in isolated situations. Thus, while the potential for harmful concentrations of herbicides to reach streams is greatest in this alternative, the likelihood of an actual adverse effect is low. Under a worst-case scenario, herbicide use preceding a “first flush” type storm could mobilize harmful concentrations of some herbicides allowed for use under Alternative D.

The Olympic LRMP as amended by the R6 2005 ROD Standard 19 requires that direct or indirect negative effects to water quality be minimized through project design. Therefore, while Alternative D allows for greater flexibility in herbicide use, mitigation would have to be added during implementation planning to ensure that no significant adverse effects to water quality would occur.

Early Detection-Rapid Response

The effects of treatment would be the same whether new or existing target species were being treated. Broadcast applications on roads having high potential for herbicide delivery, and increased flexibility near dry streams would continue to pose additional risk that is avoided in the Proposed Action. Herbicide would not likely enter water in concentrations over a level of concern because the infestations are predicted to continue to be small and scattered. There would be an annual cap on treatments within aquatic influence zones; however there would be no specific cap on herbicides applied along roads having high potential to deliver herbicide. The risk of water quality degradation would be greatest with continuous use of certain herbicides within roadside ditches.

Cumulative Effects

Similarly to the Proposed Action, the properties of the herbicides proposed for use, the types of treatments proposed, and the limitations associated with PDFs and buffers reduces the likelihood for impacts to actually occur or contribute to cumulative effects. While there would be increased risk of herbicide delivery on some roadsides, the amount of herbicide that could actually enter water would be comparatively small and rapidly diluted.

Alternative D would have the potential to contribute to significant cumulative adverse effects if rainfall occurred soon after extensive broadcast treatments and other landowners or managers simultaneously used herbicides on neighboring lands. Such a scenario is possible, but unlikely to occur. This would be more likely in watersheds having more than 10 acres of treatment within the aquatic influence zone in the upper 70 percent of a watershed (see watersheds listed under Alternative B above).

The upper 70 percent is the portion of the Forest most likely to contain small, high elevation streams where effects of lower risk project could trigger a higher level of risk (R6 2005 Monitoring Framework). Broadcast application along roads with high potential to deliver herbicide to streams, would pose a greater level of risk in these watersheds.

Aquatic Conservation Strategy Objectives

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

Alternative D would restore the diversity of watershed scale features by removing invasive plants found growing adjacent to or within aquatic influence areas. Invasive plant treatment under Alternative B would follow recommendations in watershed analysis.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

Alternative D would not likely affect chemical or physical routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species. The amount of treatment in any given watershed is small. Less than six percent of National Forest Service system lands within any single 6th field watershed are currently infested. These infestations cover less than three percent of any single 6th field watershed.

The routes for herbicide to contaminate water are treatments of emergent vegetation and potential runoff from a large rain storm soon after application, especially from treated roadside ditches. Treatment of emergent vegetation is not intended to be a direct application of herbicide to water. However, treatment of emergent vegetation may result in some minor drift to surface waters (particularly at the Cranberry Bog Botanical area and Middle Hoh River Floodplain site). Previous monitoring efforts from the State of Washington have not detected any exceedance of State drinking water standards for spot treatment of emergent vegetation. Concentrations of herbicide that could reach streams from these treatments would be far below levels of concern.

Invasive plant treatments will not create physical barriers or otherwise degrade access to aquatic habitat.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

Alternative D would restore the physical integrity of shorelines and streambanks by replacing invasive plants with native plant communities. The types of treatments proposed could result in minor streambank erosion, but since no heavy equipment would be used, impacts would be localized and short-lived. There is no risk of negatively impacting channel condition and dynamics as a result of treating invasive plants.

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

The extent and range of infestations currently found in aquatic influence zones is relatively small (about 600 acres over the National Forest as a whole, no more than 74 acres in any 6th field watershed). No more than ten acres would be treated within any 1.5 miles of stream. The amount of treatment that could occur annually in aquatic influence zones is limited by PDFs H14 and H15, so that future treatments under EDRR would not result in greater potential effects. Broadcast treatments along intermittent streams and roadside ditches in Alternative D could deliver herbicides to streams and other water bodies in sufficient quantity to affect water quality.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Treatment of invasive plants has a low probability for producing sediment because very little ground disturbance will take place when invasive plants are treated with spot-spray or hand applications. Manual, mechanical, and restoration treatments are extremely unlikely to contribute sediment. The integration of manual/mechanical/herbicide treatments would limit the potential for excessive trampling and not solely rely on manual labor. Manual labor such as hand pulling and the use of mechanical equipment to control invasive plants may result in localized soil disturbance, but increases of sediment to streams would likely be undetectable. Not all vegetation in a treated area would be pulled or removed, so some ground cover plants would remain. Not all sediment from pulling weeds along roads or use of mechanical equipment to cut weeds would reach a stream because many relief culverts intercept ditch flow and drain it on to the forest floor away from streams. Handpulling is very labor intensive and costly. Thus, few acres per year could be treated using this technique across a watershed. The amount of sediment created by manual, mechanical, and restoration treatments is anticipated to be insignificant because the methods of treatments do not include ground disturbing activities by heavy equipment. When compared to the total acres within a watershed, project-related soil disturbance from handpulling would be negligible.

Removal of invasive plants and replacement with native plant communities would restore sediment regime affected by knotweed and other target species. Projects may result in small amounts of sediment, especially related to manual and mechanical treatments, but the limited overall extent would not result in watershed-scale impacts. No heavy equipment would be used off roads in riparian reserves.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

Removal of invasive plants and replacement with native plant communities would restore future inputs of wood and leaves that provide the basic foundation of the aquatic ecosystem food webs.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Removal of invasive plants and replacement with native plant communities would restore floodplain habitat and water table elevation in meadows and wetlands.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

Removal of invasive plants and replacement with native plant communities would restore species composition and structural diversity in riparian areas and wetlands. The use of spot-spray applications of aquatic glyphosate and aquatic imazapyr near wet streams may result in some minor non-target vegetation impacts at the site scale. However, the amount necessary to affect to kill trees in a riparian area is not possible with spot-spray applications. Invasive plant treatments could temporarily reduce streamside vegetation (albeit non-native and low quality) that provides cover for fish. Risk of adverse herbicide effects would be increased from broadcast treatments near dry streams in Alternative D, however sediment, nutrient, and wood routing would not be affected at any scale.

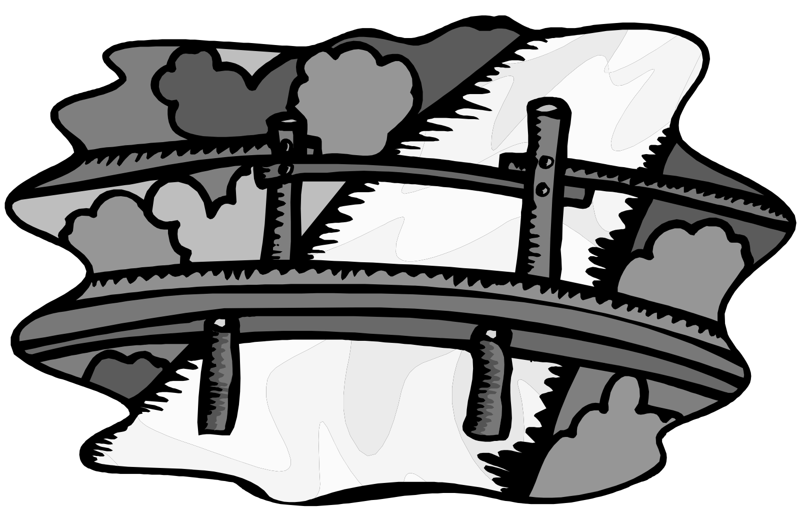
9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

Removal of invasive plants and replacement with native plant communities would restore habitat for species dependant on riparian and aquatic habitat.

Alternative Comparison – Soil and Water

Table 56-Comparison of Herbicide Use within Aquatic Influence Zones

Alternative	Amount and Character of Herbicide Use Within Aquatic Influence Zones	Estimated Proportion of Project Area Where Broadcast Methods May Be Considered	Estimated acreage of project where herbicide treatment may occur on roads with high potential to deliver herbicides to streams	Estimated proportion of project where broadcast may occur on roads with high potential to deliver herbicides to streams
No Action (Alternative A)	Fewer than 30 acres of spot and hand treatment	0 %	Fewer than 40 acres	0 %.
Proposed Action (Alternative B)	Buffers restrict broadcasting near perennial and intermittent streams; treatment of wetland emergent or streamside target vegetation would require low aquatic risk or aquatic labeled herbicides.	34%	1,420	0 %
Alternative C	None	0 %	0	0 %
Alternative D	Buffers restrict broadcasting near wet streams; treatment of wetland emergent or streamside target vegetation would require low aquatic risk or aquatic labeled herbicides. No restrictions beyond herbicide label advisories would apply to dry streams.	86%	1,420	37%



3.5 Aquatic Organisms and Habitat

The potential effect of invasive plant treatments on aquatic organisms is a primary public issue (Issue Group 5). Many people have expressed concern about the effects of herbicide use on fish and the aquatic ecosystem. Many laws, policies, standards and guidelines relate to aquatic ecosystems and activities near streams. The discussion below focuses on the likelihood of potential effects on aquatic organisms and their habitat should any alternative result in herbicides coming in contact with water. The analysis complements the Soil and Water section above.

All alternatives (including No Action) "May Impact" sensitive aquatic species, but none will affect the viability of any species or cause any species to be listed under the Endangered Species Act. All alternatives "May Affect" aquatic species listed or proposed for listing under the Endangered Species Act, but none will jeopardize the continued existence of any species. All alternatives would result in long-term restoration where natural plant communities and disturbance regimes have been altered by weeds is noted by all. None of the chemicals proposed for use would result in long-term adverse alteration of habitat (NMFS 2007 BO).

Consultation with the Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS, also referred to as NOAA Fisheries) has been completed for this project. The Forest Service worked with these agencies from project inception throughout the planning process. NMFS submitted a comment letter expressing concerns about the Proposed Action and its potential effects on listed fish (see Appendix H). Over the course of 2006 and into early 2007, there were a series of meetings and negotiations between the Forest Service, FWS and NMFS staff to develop the project description and finalize the Biological Assessment (FWS 2007 BO.).

The Biological Assessment was submitted in January 2007, covering proposed actions that were considered both "not likely" and "likely" to adversely affect aquatic species listed or proposed for listing under the Endangered Species Act. Each agency (FWS and NMFS) prepared its own documents in response to the BA, including letters of concurrence on the portions of the project they considered "not likely" to adversely affect the species (FWS April 2007 and NMFS May 2007) and Biological Opinions (BOs) for portions of the project they considered "likely" to affect such species (FWS September 2007 and NMFS October 2007). The BOs concluded that the project is not likely to jeopardize the continued existence of bull trout, Puget Sound Chinook, Hood Canal summer-run chum, or Puget Sound steelhead, or result in the adverse modification or destruction of designated critical habitat.

FWS and NMFS have authorized incidental take on the known sites as well as the EDRR approach for future detections. "Reasonable and Prudent Measures" necessary to minimize the taking of federally listed fish are documented in the BOs. The BA, letters of concurrence and BOs are available hard copy on request or via the Forest Service website: http://www.fs.fed.us/r6/olympic.

3.5.1 Affected Environment

Effects of Invasive Plants on Aquatic Ecosystems

As described previously, invasive plants found growing adjacent to or within aquatic influence areas can invade, occupy, and dominate riparian areas and indirectly impact aquatic ecosystems and fish habitat. Target species such as knotweed and blackberry can choke streams, become sediment traps and cause stream aggradation, and/or block fish access. Spawning gravels locked up in the root masses are unavailable for fish, and the stream areas around the root masses have such accelerated flows that gravels aren't retained, resulting in a net loss of fish habitat.

Invasive plants can change stand structure and alter future inputs of wood and leaves that provide the basic foundation of the aquatic ecosystem food webs. Native vegetation growth may change as a result of infestation, and the type and quality of litter fall, and quality of organic matter may decline, which can alter or degrade habitat for aquatic organisms. For example, native vegetation regeneration was reduced as a result of knotweed infestations (Lauren Urgenson, personal communication). The amount of nitrogen to aquatic ecosystems through riparian litter fall may be compromised because knotweed retains more nitrogen than native species.

The availability of nitrogen to aquatic biota and native vegetation may be significantly reduced because knotweed can uptake or hold on to 75 percent of leaf nitrogen in the root system (ibid). Primary and secondary consumers that form the basic food source for fish and other aquatic organisms may be indirectly affected.

Aquatic Species of Local Interest

The Olympic National Forest has many Aquatic Species of Local Interest including the List Of Aquatic Species Proposed Or Listed As Endangered Or Threatened Under The Endangered Species Act (Table 57) and the Regional Forester's Sensitive Species list (July 2004, see Table 60).

Fish distribution data is from WDFW and local Forest fish biologists. Appendix C displays brief summaries regarding the life history and other information for each of these species, compiled from a variety of sources. Additional information related to life history and status of populations at the Evolutionary Significant Unit (ESU) or Distinct Population Segment (DPS) scale can be found in the following sources:

- R6 2005 FEIS Fisheries Biological Assessment (BA), Environmental Baseline
- NMFS and USFWS Federal Register documents (http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Index.cfm), (http://www.fws.gov/pacific/bulltrout/),
- Shared Strategy for Puget Sound for Puget Sound Chinook Salmon, Hood Canal summer chum salmon, and bull trout population in the Puget Sound area (http://www.sharedsalmonstrategy.org/plan/docs/)
- Draft Coast Puget Sound Bull Trout Recovery Plan (http://www.fws.gov/pacific/bulltrout/recovery.html)
- http://www.nativefish.org/articles/OlympicMudminnow.php
- http://wlapwww.gov.bc.ca/wld/documents/salishsucker.pdf

Federally Listed Aquatic Species

The following species are listed as Proposed or Threatened under the Federal Endangered Species Act (ESA). Critical habitat has also been designated for some of these species. A Biological Assessment was submitted in January 2007 including actions that were considered both "not likely" and "likely" to adversely affect aquatic species listed or proposed for listing under the Endangered Species Act. Each agency (FWS and NMFS) prepared its own documents in response to the BA, including letters of concurrence on the portions of the project they considered "not likely" to adversely affect the species and Biological Opinions (BO) for portions of the project they considered "likely" to affect such species. The BOs authorize incidental take on the known sites as well as the EDRR approach for future detections.

Table 57 gives the status and watersheds providing habitat for species listed or proposed for listing under the ESA. Table 58 provides life cycle information on these species. Discussions about critical habitat and a list of treatment areas within 100 feet of listed fish bearing streams follow.

Table 57-Species Listed and Proposed For Listing ESA and their Critical Habitat within the Project Area

Species	DPS or Critical Habitat	Status/ Federal Register Reference	5th Field Watersheds on NF (Critical Habitat)	Habitat and Life History
Steelhead	Puget Sound	Proposed/ 71 FR 15666 3/29/06	Big Quilcene River, Elwha River*, Discovery Bay, Dungeness River, Dosewallips River, Duckabush River, Hamma Hamma River*, Lower West Hood Canal*, Sequim Bay, Skokomish River, Upper West Hood Canal	The most widespread run type of steelhead on Olympic National Forest is the winter (ocean-maturing) steelhead. Winter steelhead are found in nearly all coastal rivers of Washington. Impassable barriers in streams on Olympic National Forest limit their distribution. Winter run steelhead typically enter streams for spawning between November and April (Wydoski and Whitney 2003). Fry emerge in April through June and generally spend one to two years in freshwater, preferring riffle areas in the summer and occupying pools during the rest of the year (ibid).
Chinook Salmon	Puget Sound	Threatened/ 64 FR 14308 3/24/99	Elwha River*, Dungeness River, Dosewallips River, Duckabush River, Hamma Hamma River*, Skokomish River	Because of the size of Chinook, they prefer spawning habitats that includes deeper water and larger gravels than for most other salmon species. Two life history types – ocean and stream – are recognized in Chinook salmon, based upon the length of time the juvenile fish spend rearing in streams and rivers. Ocean-type Chinook move relatively quickly into saltwater following emergence. Some fry enter marine environments almost immediately, but most inhabit the shallow side margins and side sloughs for up to two months. It is unlikely that ocean-type Chinook (mostly fall Chinook) on Olympic National Forest would be exposed to disturbance and herbicides from emergent vegetation treatments. Stream-type Chinook overwinter in fresh water, typically migrating to the ocean the following spring.
	Puget Sound Critical Habitat	Designated/ 70 FR 52629 09/02/05		
Chum Salmon	Hood Canal Summer-run	Threatened/ 64 FR 14508 03/25/99	Dungeness*, Sequim Bay*, Discovery Bay*, Dosewallips River*, Duckabush River, Big Quilcene River*, Upper West Hood Canal Frontal*, Hamma Hamma River*, Skokomish River**	Freshwater migration in the Pacific Northwest is typically short in distance (<50 miles). Chum salmon utilize low gradient (1-2%), sometimes tidally-influenced reaches of streams for spawning, which limits their spawning distribution on Olympic National Forest. Most tidally-influenced areas have been disturbed in some form, which has introduced invasive species, such as knotweed along the streambanks or gravel bars.
	Hood Canal Summer-run Critical Habitat	Designated/ 70 FR 52629 09/02/05		
Bull Trout	Coastal Puget-Sound	Threatened/ 64 FR 58910 11/01/99	Hoh River, Queets River, Upper Quinault River, Lower Quinault River*, Wishkah River*, Satsop River**, Wynoochee River**, Humptulips River, Skokomish River, Dungeness River, Elwha River	Bull trout move upstream in late summer and early fall to spawn in September and October – or in November at higher elevations (Wydoski and Whitney 2003). Extended incubation periods (4 to 5 months) make eggs and fry particularly susceptible to increases in fine sediments. Fry remain in the streambed for up to 3 weeks before emerging. Fry are typically found in shallow, backwater side channels and eddies in proximity to instream cover. Juveniles are typically found in interstitial spaces in the substrate, and subadults in deeper pools of streams or in the deep water of lakes.
	Coastal Puget-Sound Critical Habitat	Designated/ 70 FR 56212 09/26/05	Does not include ONF lands	

*These species are present lower in watershed off National Forest lands.
**There was historic distribution within these watersheds on National Forest System lands.

Life Cycle Timing for Federally Listed Fish Species

Table 58-Life Cycle Timing of Federally Listed Fish Species in the Project Area

Stock	Migration	Spawning	Incubation	Rearing
Puget Sound Chinook	August to September	September to November	September to February	Saltwater only
Hood Canal Summer Chum	Late August to mid-October	September to October	September to February	Saltwater only
Bull Trout	Mid-June to November	Mid-September to mid-December	Mid-September to June	Year round
Puget Sound Steelhead	Late November to April	December to April	December to June	Year round

Designated Critical Habitat for Pacific Salmon

Critical habitat was designated for Puget Sound chinook salmon and Hood Canal summer-run chum salmon on February 16, 2000 (65 FR 7764), but vacated by court order on April 30, 2002. Critical Habitat for this species was proposed on December 14, 2004 (69 FR 74572) and designated on September 2, 2005 (70 FR 52629). Fifth field watersheds on Olympic National Forest with designated critical habitat are the Dungeness/Elwha, Hood Canal, Dosewallips, Duckabush, Hamma Hamma, and Skokomish Rivers.

NMFS designates critical habitat based on physical and biological features that are essential to the listed species. Essential features of designated critical habitat are: (1) substrate, (2) water quality, (3) water quantity, (4)water temperature, (5) water velocity, (6) cover/shelter, (7) food for juveniles, (8) riparian vegetation, (9) space, and (10) safe passage conditions (50 CFR 226.212). The three freshwater primary constituent elements of critical habitat are:

3. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
4. 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;
5. 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.

Recent designated critical habitat on the Olympic National Forest includes the stream channels in each designated reach, and a lateral extent as defined by the ordinary high water line (Sept. 2, 2005; 70 FR 52629). The primary constituent elements essential for conservation of listed ESUs are those sites and habitat components that support one or more fish life stages, including freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors.

Designated Critical Habitat for Coastal Puget Sound Bull Trout

The FWS proposed to designate critical habitat for the Coastal Puget Sound DPSs on June 25, 2004 (69 FR 35768). A final ruling was made on September 26, 2005 (70 FR 56212) to designate critical habitat for the Klamath river, Columbia River, Jarbridge River, Coastal Puget Sound, and Saint Mary-Belly River populations of bull trout in the coterminous United States. Lands proposed for critical habitat for Coastal-Puget Sound bull trout excludes National Forest System lands.

The FWS determined that PACFISH, INFISH, the Interior Columbia Basin Ecosystem Management Project (ICBMP) strategy, and the Northwest Forest Plan (NWFP) Aquatic Conservation Strategy (ACS) provide a level of conservation and adequate protection and special management for the PCEs essential to the conservation of bull trout at least comparable to that achieved by designating critical habitat. As a result, those lands are not being designated critical habitat as they do not meet the statutory definition. In many specific ways these plans are superior to a designation in that they require enhancement and restoration of habitat, acts not required by the designation.

Areas related to the scope of this EIS and exempt from designated critical habitat are NF lands under the Northwest Forest Plan. However, downstream impacts from activities on NF lands may affect critical habitat and is therefore assessed in this EIS and January 2007 Fish and Wildlife Biological Assessment and other consultation documents.

Critical habitat extends from the bankfull elevation on one side of the stream channel to the bankfull elevation on the opposite side. Adjacent floodplains are not proposed as critical habitat. The lateral extent of proposed lakes and reservoirs is defined by the perimeter of the water body as mapped on standard 1:24,000 scale maps.

The FWS critical habitat designation identified those physical and biological features of the habitat that are essential to the conservation of the species and that may require special management consideration or protection. These physical and biological features include, but are not limited to: space for individual and population growth, and for normal behavior; food, water, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, or rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distribution of a species.

All areas proposed as critical habitat for bull trout are within the historic geographic range of the species and contain one or more of these physical or biological features essential to the conservation of the species. The FWS also included a list of known primary constituent elements with the critical habitat description. The primary constituent elements may include, but are not limited to, features such as spawning sites, feeding sites, and water quality or quantity.

The FWS determined the primary constituent elements for bull trout from studies of their habitat requirements, life-history characteristics, and population biology, as outlined above. These primary constituent elements are:

6. Permanent water having low levels of contaminants such that normal reproduction, growth and survival are not inhibited;
7. Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will vary depending on bull trout life history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence;
8. Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures;
9. Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine substrate less than 0.63 cm (0.25) in diameter and minimal substrate embeddedness are characteristic of these conditions;

10. A natural hydrograph, including peak, high, low and base flows within historic ranges or, if regulated, a hydrograph that demonstrates the ability to support bull trout populations;
11. Springs, seeps, groundwater sources, and subsurface water connectivity to contribute to water quality and quantity;
12. Migratory corridors with minimal physical, biological, or chemical barriers between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows;
13. An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish; and
14. Few or no predatory, interbreeding, or competitive nonnative species present.

Treatment Areas near Streams with Listed Fish

Treatment areas (mapped infestations) within 100 feet of streams with proposed or listed fish are shown in the following table (see Appendix A for maps). Treatment areas that are not included are further than 100 feet from streams with listed fish.

Table 59-Treatment Areas within 100 Feet of Streams with Proposed or Listed Fish Species

Fifth Field Watershed Name	Stream Name	Treatment Area Identification	Listed Fish Species* and Life Stages found within Stream*
Big Quilcene River	Mainstem of Big Quilcene River	9H-09b road-related	HCS – presence/migration PSS – presence/migration, spawning and rearing
Discovery Bay	Salmon Creek	9H-05 road-related	PSS – presence/migration
Dosewallips River	unnamed	9H-11 road-related.	PSS – presence/migration
	Mainstem of Dosewallips River	9H-11 road-related.	PSS, PSC – presence/migration, spawning, rearing
	Gamm Creek	9H-11 road-related.	PSS – presence/migration, spawning
Duckabush River	Mainstem of Duckabush River	9H-13 road-related.	PSS, PSC – presence/migration, spawning, rearing
Dungeness River	Canyon Creek	9H-01 road-related	BT – presence/migration
		9H-02 road-related.	BT – presence/migration
	Mainstem of Dungeness River	9H-06a road-related	PSS – presence/migration, spawning PSC – presence/migration, spawning, rearing BT – presence/migration, rearing
		9H-30 meadow	PSS – presence/migration, spawning PSC – presence/migration, spawning, rearing BT – presence/migration
	Gray Wolf River	9H-02 road-related	PSS – presence/migration, spawning PSC – presence/migration, spawning, rearing BT – presence/migration
		9H-06a road-related	PSS – presence/migration, spawning PSC – presence/migration, spawning, rearing BT – presence/migration, rearing
Elwha River	Mainstem of Elwha River	9P-40 road-related	PSS, PSC, BT- presence/migration
	Little River	9P-40 road-related	PSS, PSC, BT- presence/migration
Hoh River	Lindner Creek	9P-41_POCU FloodPlain.	BT – presence/migration
	Tower Creek	9P-41_POCU FloodPlain	BT – presence/migration
Humptulips River	East Fork Humptulips River	9P-37 road-related.	BT – potential feeding/migratory habitat
		9P-38 road-related.	BT – potential feeding/migratory habitat
	Stevens Creek	9P-36 road-related.	BT - potential feeding/migratory habitat
	West Fork	9P-33 road-related.	BT – potential feeding/migratory habitat

Fifth Field Watershed Name	Stream Name	Treatment Area Identification	Listed Fish Species* and Life Stages found within Stream*
	Humptulips River	9P-34 road-related.	BT – potential feeding/migratory habitat
		9P-45 trails	BT - potential feeding/migratory habitat
Lower Quinault	Cook Creek	9P-43 road-related	BT – presence/migration
	Boulder Creek	9P-42 road-related	BT – presence/migration
		9P-46 Quinault RNA	BT – presence/migration
Queets River	Salmon River	9P-28 road-related.	BT – presence/migration
	Matheny Creek	9P-23 road-related	BT – presence/migration
		9P-24 road-related	BT – presence/migration
		9P-26 road-related	BT – presence/migration
		9P-27 road-related	BT – presence/migration
Satsop River	West Fork Satsop River	9H-25a road-related	BT – potential feeding/migratory habitat; historic distribution
	Walter Creek	9H-23 road-related	BT – potential feeding/migratory habitat; historic distribution
Sequim Bay	Unnamed	9H-03 road-related.	PSS – presence/migration
	Jimmycomelately Creek	9H-03 road-related.	PSS – presence/migration, spawning, rearing HCS – presence/migration
Skokomish River	Big Creek	9H-17 road-related.	PSS, BT – presence/migration
		9H-17a road-related	PSS, BT – presence/migration
	Brown Creek	9H-18 road-related.	PSS – presence/migration, spawning, rearing PSC – presence/migration BT – presence/migration, spawning
		9H-20 road-related	BT – presence/migration
	Cedar Creek	9H-19 road-related	PSS, BT – presence/migration
		9H-23 road-related	BT – presence/migration
	Church Creek	9H-19 road-related.	BT – presence/migration, spawning, rearing
	Le Bar Creek	9H-18 road-related.	PSS – presence/migration, spawning, rearing PSC, BT – presence/migration
	North Fork Skokomish River	9H-17a road-related	PSS – presence/migration PSC, BT – presence/migration, rearing
	Skinwood Creek	9H-17 road-related.	PSS – presence/migration
	Pine Creek	9H-19 road-related.	BT – presence/migration
	Rock Creek	9H-23 road related	BT – presence/migration
	South Fork Skokomish River	9H-18 road-related.	PSS – presence/migration, spawning, rearing PSC, BT – presence/migration
		9H-22 road-related.	PSS – presence/migration, spawning, rearing PSC, BT – presence/migration
		9H-23 road-related.	PSS – presence/migration, spawning, rearing PSC, BT – presence/migration
	Steel Creek	9H-18 road-related.	BT – presence/migration
Upper Quinault River	Gatton Creek	9P-32 SummerHome	BT – presence/migration
		9P-32a trails	BT – presence/migration
	Willaby Creek	9P-32 SummerHome	BT – presence/migration
		9P-32a trails	BT – presence/migration
Wynoochee River	Wynochee River	9H-27 road-related	BT – presence/migration

*PSC = Puget Sound Chinook, PSS = Puget Sound Steelhead, HCS = Hood Canal summer-run Chum, BT = Coastal Puget Sound Bull Trout

Essential Fish Habitat (Magnuson-Stevens Act)

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance essential fish habitat (EFH) for those species regulated under a Federal fisheries management plan.

Essential Fish Habitat is defined in the Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Essential Fish Habitat includes all freshwater streams accessible to anadromous fish (Chinook, coho, and Puget Sound pink salmon), marine waters, and inter-tidal habitats.

Olympic National Forest may incorporate an EFH assessment into this EIS pursuant to 40 CFR section 1500. NEPA and ESA documents prepared by the Olympic National Forest should contain sufficient information to satisfy the requirements in 50 CFR 600.920(g) for EFH assessments and must clearly be identified as an EFH assessment.

The geographic extent of EFH on the Olympic National Forest is specifically defined as all currently viable waters and most of the habitat historically accessible to Chinook, coho, and pink salmon within the watersheds identified in Table 59. Salmon EFH excludes areas upstream of longstanding naturally impassible barriers (i.e., natural waterfalls in existence for several hundred years). Salmon EFH includes aquatic areas above all artificial barriers.

Regional Forester Sensitive Aquatic Species

The following table identifies Regional Forester's Sensitive species in the project area. Regional Forester's Sensitive Species are managed to maintain species viability.

Table 60-Regional Forester's Sensitive Species within the Project Area

Comment [js1]: Because of the amount of text in the 4th column, I would make this table landscape. At least look at it that way, I think it would be easier to read

Species	ESU or DPS	5th Field Watersheds on NF	Habitat and Life History
Chinook Salmon	Washington Coast	Soleduck River, Calawah River, Bogachiel River, Hoh River, Clearwater River*, Queets River, Whale Creek/Raft River*, Upper Quinault River, Lower Quinault River*, Humptulips River, Wishkah River*, Wynoochee River, Satsop River*	Because of the size of Chinook, they prefer spawning habitats that includes deeper water and larger gravels than for most other salmon species. Two life history types – ocean and stream – are recognized in Chinook salmon, based upon the length of time the juvenile fish spend rearing in streams and rivers. Ocean-type Chinook move relatively quickly into saltwater following emergence. Some fry enter marine environments almost immediately, but most inhabit the shallow side margins and side sloughs for up to two months. Stream-type Chinook overwinter in fresh water, typically migrating to the ocean the following spring.
Coho Salmon	Puget Sound/Strait of Georgia	Elwha River*, Dungeness River, Sequim Bay, Discovery Bay, Upper West Hood Canal Frontal, Big Quilcene River, Dosewallips River, Duckabush River, Hamma Hamma River*, Lower West Hood Canal Frontal*, Skokomish River	Coho salmon are found in a broader diversity of habitats than any other anadromous salmonid, from small tributaries of coastal streams to inland tributaries of major rivers (Meehan and Bjornn 1991). In the autumn, as water temperatures decrease, juvenile coho move into available side channels, spring-fed ponds and other off-channel sites to avoid winter floods. Streams with more structure (logs/rootwads, boulders, undercut banks) support more coho because they provide both food and cover.
Chum Salmon	Puget Sound/Strait of Georgia	Elwha River*, Dungeness*, Sequim Bay*, Discovery Bay*, Upper West Hood Canal Frontal*, Big Quilcene River*, Dosewallips* River, Duckabush River, Hamma Hamma River*, Lower West Hood Canal Frontal*, Skokomish River	Freshwater migration in the Pacific Northwest is typically short in distance (<50 miles). Chum salmon utilize low gradient (1-2%), sometimes tidally-influenced reaches of streams for spawning, which limits their spawning distribution on Olympic National Forest. Most tidally-influenced areas have been disturbed in some form, which has introduced invasive species, such as knotweed along the streambanks or gravel bars.
	Pacific Coast	Pysht River/Clallam River*, Lyre River/Twin River*, Hoh River, Clearwater River*, Whale Creek/Raft River*, Upper Quinault River, Lower Quinault River*, Humptulips River, Wishkah River*, Wynoochee River*, Satsop River*, Queets River,	

Species	ESU or DPS	5th Field Watersheds on NF	Habitat and Life History
Sockeye Salmon	Lake Pleasant Sockeye	Soleduck River*	Populations of lake spawning sockeye are found in Quinault Lake on Olympic National Forest and in Lake Pleasant below National Forest boundary. Most sockeye spawning occurs in rivers and streams that are tributaries to lakes, but often substantial numbers of sockeye salmon spawn along lake shores in areas where ground water percolates through gravel. Generally, sockeye utilize areas along lake shores where the gravel is small enough to be readily dislodged by digging. Sockeye, however, may also utilize lake shore areas with other substrate types and sizes, depending largely on the presence or absence of upwelling. Lake Pleasant sockeye salmon ascend the Quillayute and Sol Duc Rivers and Lake Creek to spawn in Lake Pleasant, Washington but have not extended up onto lands within Olympic National Forest. The Forest boundary is about 2.5 miles upstream from the lake.
	Quinault Lake	Upper Quinault River	Quinault sockeye spawn in the Quinault River drainage and rear in Quinault Lake, Washington. The southern shoreline of Quinault Lake is bordered by summer home tracts which are included in the 9P-32 treatment area. Treatment area 9P-32a includes a trail system above the summer home tracts and crosses three major creeks that flow through treatment area 9P-32; Willaby Creek, Falls Creek, and Gatton Creek. These three creeks contain natural barrier falls in the lower reaches. Treatment area 9P-32 includes patches of Japanese knotweed, herb Robert, English ivy and English holly, estimated to cover approximately 96 acres. The treatment of emergent Japanese knotweed or other emergent invasives below the high water mark along the shoreline of Lake Quinault may impact individual sockeye.
Coastal Cutthroat Trout	Puget Sound	Elwha River, Dungeness River, Sequim Bay, Discovery Bay, Upper West Hood Canal Frontal, Big Quilcene River, Dosewallips River, Duckabush River, Lower West Hood Canal Frontal, Hamma Hamma River, Skokomish River	The Puget Sound populations of coastal cutthroat trout enter protected marine waters in northwestern Washington, which includes waters draining the east side of the Olympic National Forest. Coastal cutthroat trout exhibit diverse life histories with four distinct life history patterns. The life history patterns include anadromous populations, which migrate to the ocean or estuary for usually less than one year before returning to freshwater; fluvial populations that migrate between small spawning tributaries and main rivers downstream; adfluvial populations migrate between spawning tributaries and lakes or reservoirs; and nonmigratory resident forms (Quigley and Arbelbide 1997). In Washington, the anadromous cutthroat is typically referred to as "searun" cutthroat and is widely distributed in the lower Columbia River and the Coastal and Puget Sound drainages. Cutthroat typically spawn in small streams with juveniles remaining in freshwater. The anadromous juveniles undergo the morphological, physiological and behavioral changes required for migration and adaptation to salt water, much like the anadromous salmonids. In Washington, most coastal cutthroat spawn from January up to July, depending on life form. Spawning occurs in riffles where the water depth is about 15 to 45 cm, in areas of low gradient and low flow (WDFW 2000). Newly-emerged fry move quickly to low velocity water at stream margins and backwaters and remain there through the summer to feed. However, in the presence of coho juveniles, which emerge earlier and at a larger size, cutthroat are often driven into higher-velocity waters (ibid). Juveniles tend to move to log jams and overhanging banks to shelter during winter. They tend to remain in small streams for about a year then begin to migrate over longer distances within their natal river system (ibid). They are also known to hybridize with steelhead.

Species	ESU or DPS	5th Field Watersheds on NF	Habitat and Life History
Coastal Cutthroat Trout	Olympic Peninsula	Pysht River/Clallam River, Lyre River/Twin River, Soleduck River, Calawah River, Bogachiel River, Hoh River, Clearwater River, Queets River, Whale Creek/Raft River, Upper Quinault River, Lower Quinault River,	Olympic Peninsula cutthroat are found from the Strait of Juan de Fuca west of the Elwha River and coastal streams south to, but not including, streams that drain into Grays Harbor. See above for further discussion about coastal cutthroat trout.
Olympic Mudminnow	N/A	Lower Quinault River, Satsop River*	The center of abundance of the Olympic mudminnow is on the west coast of the Olympic peninsula, where its habitat extends from the Chehalis River system north to the Quinalt River. Although these fish are known to live primarily in wetland habitats, they are also found in slow-moving streams and ponds, and have been collected from a shallow drainage ditch off state Highway 9 along the sandy beaches of the Pacific Ocean. It has a surprisingly wide tolerance for temperature extremes (from 0 C. to about 30 C.) and it can live at oxygen levels so low that they would be lethal to most other fishes. It appears, however, that this species is very selective as far as salinity and water current are concerned. Required habitat characteristics are several centimeters of soft mud bottom substrate, little to no water flow, and abundant aquatic vegetation. Currently there are no treatment sites that include known locations of Olympic mudminnows. Invasion by exotic plants and animals have resulted in wetland loss and habitat degradation for the Olympic mudminnow (Mongillo and Hallock 1999).
Salish Sucker	N/A	Skokomish River*	The only known salish sucker populations in Washington occur in lake and slough habitats. Salish sucker inhabit Lake Cushman, which is within the Skokomish river and located in the Hood Canal District of the Olympic National Forest. Most suckers spend the majority of their time at the bottom of lakes or other quiet waters, feeding on invertebrates (Wydoski and Whitney 2003). Treatment area 9H-17a is road-related treatment located along the northwestern portion of Lake Cushman and crosses several small tributaries to the lake.

*These species are present lower in watershed off National Forest lands.
**Species historically present within these watersheds on National Forest lands.

3.5.2 Environmental Consequences

The following section discusses effects from non-herbicide and herbicide treatment methods occurring near streams that provide habitat for fish. A Biological Assessment (BA) was prepared for this project and submitted to the FWS and NMFS as a part of ESA Consultation (January 2007). The BA is summarized in this chapter. FWS and NMFS responded to the BA with letters of concurrence and formal Biological Opinions (BOs). The BOs authorize incidental take for known sites and the EDRR program. All consultation documents are available on our website: http://www.fs.fed.us/r6/olympic or in hard copy by request.31

Several lengthy documents are incorporated by reference including the R6 2005 FEIS and accompanying Fisheries Biological Assessment, Biological Opinions, and SERA Risk Assessments (1997a, 1997b, 1999a, 1999b, 2001a, 2001c, 2003a, 2003b, 2003c, 2003d, 2003e, 2003f). Details about the risk assessment methodologies, toxicity indices for fish and other aquatic organisms, and Hazard Quotient values are not repeated in the project level FEIS. The SERA Risk Assessment scenarios were used as indicators of situations where PDFs and buffers would be necessary to minimize adverse effects on the aquatic ecosystem.

[31] Each regulatory agency completed a Letter of Concurrence (FWS April 2007, NMFS May 2007) and a Biological Opinion (FWS September 2007, NMFS October 2007).

The impacts of invasive plants on the environment can last decades, while the impacts of treatment tend to be short term (one year or less). Passive and active restoration would accelerate native vegetative recovery in treated sites.

Effects from Non-Herbicide Treatments

Manual and mechanical invasive plant treatments occurring near streams and wetlands pose risk of disturbing the aquatic ecosystem.32 All alternatives, including No Action, allow hand pulling and other treatments that may result in minor, short term disturbances to fish and other aquatic organisms.

Manual and mechanical treatments can result in increased erosion, stream sedimentation, and disturbance to aquatic organisms if carried out over a large enough area. Sedimentation can cover eggs or spawning gravels, reduce prey availability, and harm fish gills. Soil can also become compacted and prevent the establishment of native vegetative cover.

Manual and mechanical treatments can reduce insect biomass, which would result in a decrease in the supply of food for fish and other aquatic organism. The presence of people or crews with hand-held tools along streambanks could lead to localized, short-term adverse effects to fish habitat because of trampling, soil sloughing due to stepping on banks and removal of invasive plant roots. However, the Implementation Planning Process and PDFs would identify and mitigate this potential effect through site specific design considerations.

Sediment/turbidity generated at the localized scale would be greatest under Alternative C because of the reliance on manual and mechanical methods and exclusion of herbicides, which has the potential to increase the amount of people working an area and soil disturbance. These impacts are known to be short term and relatively insignificant (see Appendix J of the R6 2005 FEIS). Effective invasive plant treatment and restoration of treated sites would improve the function of riparian areas and lead to improved fish habitat conditions in the years following passive and active restoration.

Invasive plant treatments may decrease riparian vegetative shading in discrete areas, thereby increasing the amount of solar radiation striking the water. Acres of target vegetation along a stream would need to be removed (without any shade-producing vegetation remaining) for water temperature to increase. This situation is unlikely to occur and there are no known invasive plants providing important riparian shade.

Herbicides in Aquatic Ecosystems

As discussed in Chapter 3.4, herbicide treatments along streams and roadside ditches may result in herbicide reaching water bodies through drift, runoff, and/or leaching. The movement, persistence, and fate of an herbicide in the environment determine the likelihood and the nature of the exposure fish and other aquatic organisms may receive. The primary determinants of exposure of herbicide to fish are herbicide properties, application rate, extent of application, application timing, precipitation amount and timing, and proximity to habitat (NMFS 2007 BO). Herbicides coming in contact with water would be infrequent and limited in extent (small, scattered infestations) and duration (minutes to hours). Even if toxicity indices for fish are temporarily exceeded at a treatment site, [lethal] exposure to bull trout [and other fish species] is unlikely to occur due to high base flows and the limited duration and extent of effects associated with invasive plant treatments (FWS 2007 BO).

Herbicides can alter the structure and biological processes of both terrestrial and aquatic ecosystems; these effects of herbicides may have more profound influences on communities of fish and other aquatic organisms than direct lethal or sublethal toxic effects (Norris et al. 1991). Stream and lake sediments may be contaminated with herbicides by deposition of soils carrying adsorbed herbicides from the land or by adsorption of herbicides from the water. Reductions in cover, shade, and sources of food from riparian vegetation could result from herbicide deposition in a streamside zone (ibid.).

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[32] These effects of non-herbicide methods are not of particular concern to the public (see Appendix G for Public Comments and Responses).

Residues in food from direct spraying are likely to occur during and shortly after application. Drift from herbicides considered for use may affect aquatic vegetation at low concentrations, however it shows little tendency to bioaccumulate and is likely to be rapidly excreted by organisms as exposure decreases (ibid.).

The application rate and method, along with the behavior of the herbicide in the environment, influence the amount and length of time an herbicide persists in water, sediment, or food sources. Once in contact, the herbicide must be taken up by the organism and moved to the site of biochemical action where the chemical must be present in an active form at a concentration high enough to cause a biological effect (ibid.).

Herbicides have been shown to affect aquatic ecosystem components; however, concentrations of herbicides coming in contact with water following land-base treatments are unlikely to be great enough to cause such changes (ibid). While the herbicides considered for use in this project kill aquatic plants, aquatic habitats and the food chain would not be adversely impacted because

- The amount of herbicide that could be delivered is relatively low in comparison with levels of concern
- The duration to which any non-target organism (including aquatic plants) would be exposed is very short-lived and impacts to aquatic plants would be localized

Herbicide Ingredients

Table 61 characterizes the sensitivity of elements of the aquatic ecosystem to herbicide impacts, based on worst case exposure scenarios in the SERA risk assessments. The risk assessments indicate that two herbicides proposed for use in this project (glyphosate and triclopyr) may cause sublethal effects on adult fish. Several of the ten herbicides proposed for use may also impact aquatic invertebrates, macrophytes and plants. Sublethal effects can include changes in behaviors or body functions that are not directly lethal to the aquatic species, but could have consequences to reproduction, juvenile to adult survival, or other important components to health and fitness of the species. The results of SERA risk assessments were quantified in the R6 2005 FEIS and associated BA. For brevity, the range of hazard quotient values predicted based on this model are not repeated here.

Table 61-Summary of Herbicide Aquatic Risk Assessment

Herbicide	Aquatic Risks
Chlorsulfuron (Telar, Glean, Corsair)	Exposure to fish and aquatic invertebrates far below levels of concern (no effects to egg and fry); peak exposures could damage aquatic plants at typical and high application rates; algae may be damaged at high rates
Clopyralid (Transline)	Exposures very far below levels of concern for fish and aquatic invertebrates; aquatic plants and algae are not susceptible.
Glyphosate (Accord XRT, Rodeo, Roundup, Roundup Pro, Aquamaster, etc, including 35 formulations)	Aquatic formulation could exceed level of concern for fish at typical and highest application rate; exposures below level of concern for aquatic invertebrates, algae, and plants. Surfactants (tallow amine or POEA) in non-aquatic use formulations very toxic to aquatic organisms, surfactant formulations may cause fish mortality at high application rate only, low toxicity to aquatic invertebrates; aquatic plants and algae are susceptible to glyphosate but exposures are below levels of concern;
Imazapic (Plateau)	Exposures far below level of concern for fish (no effects to egg & fry); potential risk to aquatic plants at highest application rate only; no risk to algae.
Imazapyr (Arsenal, Arsenal AC, Chopper, Stalker, Habitat)	Exposure to fish and invertebrates very far below levels of concern; potential risk to aquatic plants at typical and high application rate, no risk to algae.
Metsulfuron Methyl (Escort XP)	Exposures to fish very far below level of concern (no effects to egg & fry); can damage aquatic plants in acute exposures, no risk to algae.
Picloram (Tordon K, Tordon 22K)	Exposures exceeded level of concern for listed fish at typical and highest application rate; salmonids appear to be marginally more sensitive to technical grade picloram (acid) than other fish species.
Sethoxydim (Poast, Poast Plus)	Highly toxic to fish due to petroleum inert; exposure exceeds level of concern for federally listed fish at typical rate and maximum exposure assumptions.
Sulfometuron methyl (Oust, Oust XP)	Exposures below level of concern to fish (highly toxic to embryo hatch).

Herbicide	Aquatic Risks
Triclopyr (Garlon 3A, Garlon IV, Forestry Garlon IV, Pathfinder II, Remedy, Remedy RTU, Redeem R&P)	Ester formulation (Garlon IV) and Metabolite TCP is toxic to fish and aquatic invertebrates; salt/acid formulation low toxicity to fish; exposures exceed level of concern for federally listed fish at typical rate but not other fish even at highest application rate; no TCP exposures exceed level of concern; only salt from exceeds level of concern for aquatic plants, and algae not at risk.

The PDFs and buffers were developed based on the relative risk of each herbicide to the aquatic environment. The PDFs minimize or eliminate potential for herbicides to enter water at concentrations of concern by limiting the rate, extent, or herbicide application method. For instance, PDF H14 limits extent of annual treatment to about 18 percent of any aquatic influence zone, which would result in at least a five-fold reduction in herbicide exposure compared to the worst case modeled scenarios. In addition, limitations on broadcasting would result in much spottier coverage compared to the modeled assumptions. Broadcasting is greatly restricted near streams in all alternatives and would never exceed the typical application rate.

No methodology is available to quantify the effect of PDFs and site-specific restricted herbicide use buffers in reducing predicted HQ values under SERA risk assessment scenarios. SERA worksheets are available to refine some site-specific parameters; however the effect of the PDFs in restricting the timing, extent, location, herbicide selection, and application rate cannot be modeled.

Inert Ingredients-Adjuvants, Impurities and Surfactants

Inert ingredients, including adjuvants, impurities and surfactants, were studied as a part of SERA risk assessment for all herbicides (see section 3.1 this Chapter). POEA surfactant may be toxic to aquatic species (SERA, 2003-Glyphosate, p. 4-14). In the SERA risk assessment, the toxicity of non-aquatic glyphosate is considered together with this surfactant, either in the formulation or added as an adjuvant in a tank mixture (SERA, 2003-Glyphosate, p. 4-14). NPE based surfactants were classified as a low risk to aquatic organisms because predicted concentrations were less than the estimated or measured “no observable effect concentration”. Other surfactants did not influence the risk assessment findings.

SERA Worksheets

SERA has developed Risk Assessment Worksheets (SERA 2004c) to refine worst-case herbicide delivery analysis from riparian treatments, using site-specific information. The worksheets incorporate the behavior of the various herbicides in the environment, along with local soil and weather information, to estimate herbicide concentration in a stream. Methodology of the SERA Worksheets is discussed in detail in the 2007 BA and in SERA 2004c.

The results can be compared to toxicity indices for fish, invertebrates and aquatic plants to indicate degree of hazard associated with herbicide predicted to enter water. The toxicity thresholds were developed in laboratory studies, often measuring the results of herbicide exposure to fish over a 96 hour period.

As discussed previously, hazard quotients less than one would indicate a very low potential for impact to aquatic organisms. Site-specific SERA Worksheets were run for two sites proposed for treatment within the aquatic influence zone, the Cranberry Bog and Middle Hoh River Floodplain treatment areas. While treatments would be preferred during dry times of the year, when herbicide is least likely to contact water, these areas may remain wet year round.

Results are described under the Proposed Action (Alternative B) below. The SERA worksheets indicate the potential for herbicides to be delivered in concentrations that exceed the toxicity threshold for fish and other aquatic organisms.

Emergent Vegetation Analysis

The SERA Worksheets do not explicitly address treatments of emergent vegetation below bankfull of a stream or wetland. Slower backwater areas may not dilute herbicides as quickly, and herbicide may remain in lentic water bodies (i.e. ponds) longer than predicted. These factors lead to some uncertainty about whether the SERA Worksheets adequately estimate the risk associated with emergent vegetation treatments.

The Forest Service also conducted an “emergent vegetation analysis” developed in collaboration with NMFS to estimate peak concentrations from treatments below bankfull of a small stream or wetland. The "emergent vegetation" analysis estimated of the potential concentration in water of aquatic labeled herbicides applied to one acre given two stream flow rates. Herbicide concentration within one square foot of water was also calculated. The emergent vegetation analysis indicates the potential for herbicides to reach a level of concern for fish and other aquatic organisms.

Results of the emergent vegetation analysis are operationally infeasible and unrealistic, because an applicator would have to pour or spray herbicide directly into a foot of water to approach the calculated concentration levels (direct application to water is not proposed for this project). The emergent vegetation analysis has not been peer-reviewed and is a relative indicator of potential effects. It is imprecise and does not account for PDFs and buffers. The calculation does not incorporate local soil or weather information, foliar interception, nor does it integrate the behavior of the different herbicides in the environment.

Results of the emergent vegetation analysis are described for the Proposed Action (Alternative B) below.

Ditches and Intermittent Channels

NMFS 2007 BO reported that herbicides applied within ditches and intermittent stream channels may be 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 erosion of exposed soil. 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.

NMFS 2007 BO also reported that glyphosate, sethoxydim, and triclopyr use modeled for this project exceeded the fish HQ threshold level of 1, causing likely adverse effects on listed salmonids and their habitat from rain within 24 hours after application at ditch and intermittent channel confluences with perennial streams.

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. NMFS also reported that several herbicides delivered through application near dry streams and/or roadside ditches would adversely affect aquatic macrophytes, invertebrates and plants (NMFS 2007 BO).

NMFS findings do not consider that glyphosate would be bound to soil present in the dry stream or ditch and therefore would not be plausibly delivered to a stream 660 feet away from the site of application. These findings assume “complete treatment” of a long stretch of dry stream or roadside ditch, which does not account for the patchy distribution of known infestations, topography of Forest Service roads, nor the presence of ditch relief pipes. NMFS findings also do not account for the mitigating effects of PDFs and buffers specific to dry streams and roadside ditch networks. Finally, NMFS findings do not consider the short period of time that fish could possibly be exposed to herbicides at the concentrations predicted in their analysis. The threshold of concern for fish in the SERA Risk Assessments assumed that fish would be exposed to a given herbicide concentration for 96 hours. Any herbicide delivered from roadside ditches would be diluted in a matter of minutes.

The FWS 2007 BO reported that treatment area 9H-20 parallels Brown Creek for 1.2 miles and crosses 7 tributary streams within the aquatic influence zone. This road segment was not identified as having a high-potential for sediment delivery, so some of the minimization measures associated with high delivery roads may not be applied in this area. Under the right conditions (extensive spot spray applications, immediately followed by a rain event) roadside treatments in this area could result in bull trout exposure to herbicide, and individual bull trout may suffer short-term impairments associated with herbicide applications in ditches and intermittent streams under these conditions. Actual exposure concentrations and durations at or near confluences with perennial streams will depend on a variety of factors, including the extent of the herbicide application within the ditch/intermittent stream, application rate, extent of riparian applications, and rainfall timing, intensity, and amount.

Direct, Indirect and Cumulative Effects by Alternative

The alternatives vary as to the degree of risk to aquatic organisms from herbicide and non-herbicide treatments. All action alternatives minimize or avoid adverse effects to some degree. The PDFs and buffers related to aquatic influence zones and roads having high potential to deliver herbicide vary between alternatives, leading to differences in degree of risk. None of the alternatives would likely result in direct mortality to fish or measurable, observable impacts.

Alternative A (No Action)

The No Action Alternative A would continue the currently approved use of herbicides on 86 acres of the Olympic National Forest. Aquatic-labeled glyphosate may be injected in streamside knotweed as part of the existing program. Otherwise, treatments with herbicide would be unlikely to occur near fish habitat. Alternative A does not allow any use of herbicides other than the 86 identified acres (no early detection or rapid response approach included). Little potential exists for herbicides to enter water in concentrations above any threshold of concern that could adversely affect aquatic organisms or ecosystems. This alternative does not include an Early Detection-Rapid Response Component.

SERA Worksheets and Emergent Vegetation Calculation

The SERA Worksheet and Emergent Vegetation Analysis was not conducted for Alternative A because the herbicide use currently approved is unlikely to result in herbicide delivery to streams.

Effects to Aquatic Species Proposed or Listed under ESA

No adverse effects would be associated with existing treatments under the current NEPA documents. Treatments are mainly minor non-herbicide treatments that occur within and outside riparian areas. Treatments are limited in extent across the Forest.

Effects on Designated Critical Habitat and Essential Fish Habitat

No adverse effects from treatment would occur on Designated Critical or Essential Fish Habitat. However, under Alternative A, invasive plants are more likely to continue to degrade these habitats because so little of the infestations would be treated. Non-herbicide methods may also have adverse effects on aquatic organisms (see discussion below under Alternative C). However the low acreage currently approved for treatment limits the potential significance of these effects – ground disturbance would remain minor, short-lived, limited extent and have negligible adverse effects.

Effects to Regional Forester's Sensitive Fish Species

Minor upland ground disturbance associated with Alternative A would not affect any sensitive fish species. Existing treatments are not extensive enough in riparian areas to affect aquatic organisms or habitat.

Cumulative Effects

Alternative A would not contribute to significant cumulative effects at any scale. Sediment delivery would be negligible and would not accumulate downstream. There would be no discernable effect to fish or aquatic organisms from treatments.

To the extent that invasive plants occupy riparian habitats, over time, fish habitat may be adversely affected. This potential is greatest under Alternative A because it would not effectively treat invasive plants that impact fish habitat.

Alternative B (Proposed Action)

The Proposed Action was designed to limit the potential for higher or moderate risk herbicide to come in contact with water where fish or other aquatic organisms are present, even if an unexpected storm occurred shortly after treatment. The amount of herbicide that would be available for runoff, leaching and/or drift is necessarily limited by restrictions on broadcast use. Spot and hand/select treatments do not have high potential to deliver herbicide because the treatments are directed at target vegetation and herbicide is quickly taken up by the plant.

The probability that fish would be exposed to non-aquatic formulations of herbicide is very low due to PDFs and buffers that require aquatic formulations for spot applications near perennial streams and wetlands. The probability of hand-select methods, such as foliar painting a knotweed leaf, resulting in herbicides coming in contact with water is low. Localized effects to individual aquatic plants are possible as a result of treatments that occur within the bankfull channel. These localized effects would not disrupt aquatic ecosystem function of the aquatic food web because of the low potential to reach toxicity levels for each trophic level under spot and hand/select applications with glyphosate and imazapyr. Spot applications of aquatic formulations of glyphosate and imazapyr are not likely to result in harmful amounts coming in contact with water and harming fish, invertebrates, and algae. However, some aquatic plants would be damaged at the immediate spot spray locations if enough herbicide comes in contact with the aquatic plant. It is believed that there will not be enough herbicide coming in contact with water to result in extensive aquatic plant mortality. For example, the use of glyphosate will not be applied directly to water for weed control, but if it does enter the water it is bound tightly to dissolved and suspended particles and to bottom sediments, and quickly becomes inactive.

In general, juvenile and adult fish will avoid the presence of human beings and will more than likely swim away from predator like shadows overcasting waterbodies. The possibility of a fish being present in the immediate water column where spot spray applications may be taking place up to the water's edge is low. However, fry avoid faster flows and tend to rear along the shoreline or around large substrate/wood where flow is slower. Fry tend to avoid overcasting shadows as well but can return to their previous location after being disturbed if a human stands still enough near the stream margin. It is unlikely that an applicator will stand still for a period of time when treating emergent vegetation.

Fish may be exposed to aquatic formulations of glyphosate and imazapyr where there is emergent vegetation treatment in smaller streams where they are present. Fish in the mainstem of rivers and streams would have substantially less risk of exposure because of a river's large flow and the relatively low proportion of fish that occur immediately along a river's edge. Smaller streams however, do not have as much flow and may not dilute herbicides as quickly. Fish in smaller streams tend to be juveniles and fry. Although there will be no herbicide applied directly to the water column for purposes of treating submerged vegetation, there may be some fine droplets from spot applications coming in contact with water as a result of treating emergent vegetation. See water contamination from drift discussion above.

Under the Proposed Action, spot-spray applications of aquatic glyphosate can occur directly within ditches and dry stream channels. Hand/select applications of clopyralid, imazapic, imazapyr (aquatic formulation), metsulfuron methyl, and triclopyr (aquatic formulation) is also proposed within ditches and dry intermittent channels. Based on the information presented above, it is reasonable to assume that aquatic organisms may be briefly exposed to toxic levels of glyphosate or other herbicide compounds if a rainfall event occurs shortly after an application. To be exposed, individuals would need to be near the confluence where a ditch or intermittent stream channel is located when the "first flush" event occurred (FWS 2007 BO).

SERA Worksheets

Local conditions at the Cranberry Bog and Middle Hoh floodplain site were analyzed for the potential amount of herbicide coming in contact with water using the SERA Risk Assessment Worksheets, assuming that water at both these locations was at bankfull. This analysis addresses the riparian area from bankfull to upland and assumes a 10 acre treatment area (approximately 50 foot wide and 1.5 miles long). Local information gathered for the worksheets was soil texture and precipitation. Soil texture in both areas is predominantly loam and annual precipitation of 50 inches for the Cranberry Bog, and 150 inches for the Middle Hoh floodplain site. Modeled concentrations of imazapyr, glyphosate, and triclopyr TEA were derived from tables in the respective risk assessments for average and peak water contamination rates based on soil and precipitation, for small streams and small pond scenarios.

The SERA Worksheets indicated that all hazard quotient (HQ) values would be below 1; therefore, no levels of concern were exceeded. The worst case assumptions for the scenario are not possible on the ground under the proposed action because there will be no broadcasting within at least 50 feet of wet or dry streams. No broadcasting would occur on roads that have high risk of herbicide delivery through their ditch networks. In addition, triclopyr would not be broadcast under any conditions. These PDFs greatly reduce the potential for herbicide delivery compared to the modeled predictions (see monitoring results Berg 2004, ODOT 2003-2005).

The R6 2005 FEIS notes that as HQ increases above 1, the margins of safety decrease, compared to the most sensitive toxic effect shown in laboratory studies.

Strategies for reducing risks include: reducing the application rate of the herbicide; applying buffers; restricting applications to more favorable site conditions and/or using an application method with less exposure. Treatments with estimated HQ's greater than 10 would be of particular concern.

The water contamination rates (mg/L per lb/acre), peak concentrations in water, and range of Hazard Quotients for worst case scenario in the Cranberry Botanical bog and Middle Hoh River floodplain site, for aquatic glyphosate, aquatic imazapyr, and aquatic triclopyr at the typical application rate are shown below.

The toxicity indices shown in Table 62 are based on laboratory studies, often measuring the results of 96 hours of exposure to fish at a certain herbicide concentration level. This duration of exposure is impossible given the mixing and dilution that occurs in the aquatic environment.

Table 62-Precipitation Rates, Peak Water Contamination Rates, Range of Concentration in Water, and Hazard Quotients for Listed Fish

Herbicide/ location	Annual Precipitation (inches)	Peak Water Contam. Rate (mg/L per lb/acre)	Range of Concentration in water (dose) (mg/L)	Toxicity Index for Listed Fish (mg/L)	Range of Hazard Quotients
Glyphosate (2 lbs/acre)					
Cranberry Botanical Bog (pond)	50	0.002 - 0.004	0.004 - 0.008	0.5 0.1 (Tierney)	0.008 - 0.02
Middle Hoh (stream)	150	0.104 - 0.161	0.209 - 0.322	0.5 0.1 (Tierney)	0.4 - 0.6
Imazapyr (0.45 lbs/acre)					
Cranberry Bog (pond)	50	0 – 0.00002	0 – 0.000011	5.0	0 – 0.000002
Middle Hoh (stream)	150	0.00009 – 0.0001	0.000042 – 0.000047	5.0	0.000008 – 0.00001
Triclopyr TEA (1 lbs/acre)					
Cranberry Bog (pond)	50	0.042 – 0.074	0.042 – 0.074	0.26	0.2 – 0.3
Middle Hoh (stream)	150	0.195 – 0.245	0.195 – 0.245	0.26	0.8 – 0.9

The low values modeled in the worksheet are not likely be approached given that treatment methods for the Cranberry Bog and Middle Hoh floodplain site are limited to spot and hand/selective methods. Hand/selective methods have less likelihood of herbicides coming in contact with water than spot spray (which far reduces exposure potential compared to broadcast treatment). Under the proposed action, spot treatments using aquatic glyphosate and aquatic imazapyr could occur within the Cranberry Botanical Bog and Middle Hoh River floodplain sites.

New information has come to light since the release of the DEIS. Tierney et al. (2006) studied the effects of five herbicides, including aquatic glyphosate, on coho salmon olfaction (i.e. smell). Coho salmon olfaction ability was reduced within 10 minutes of exposure to 1.0 mg/L of aquatic glyphosate, and more rapidly to higher concentrations. There was no effect to olfaction ability when the aquatic glyphosate concentration was reduced to 0.1 mg/L. No concentrations were tested between 1.0 and 0.1 mg/L, which means that the true NOEC value may have been anywhere between 1.0 and 0.1 mg/L. This NOEC value is based on laboratory studies or pure water and thus may not be applicable to stream situations where soil is present in the water.

Given this new information, hazard quotients from the SERA risk assessment worksheets for glyphosate were recalculated using 0.1 mg/L as the NOEC value with the understanding that the true NOEC value is somewhere between 1.0 and 0.1 mg/L. Hazard quotient values using the upper range of concentrations in water from Table 62 range from 1 to 3. This new information confirms that potential non-lethal impacts to fish cannot be entirely discounted. However, given the ground conditions and application methods, along with PDFs and buffers, the potential for harm to the aquatic ecosystem is low. The Tierney 2006 paper described the reaction of fish to glyphosate added directly to water in a tank, with no consideration given to the behavior of glyphosate in the environment. Glyphosate binds readily to soil, even in water, so the olfactory effects may not be applicable to actual field conditions.

NMFS 2007 BO reported that within aquatic influence zones, triclopyr used at maximum application rates by hand or selective methods (in locations with rainfall rates between 50 to 100 inches per year), and glyphosate applied at both typical and maximum rates, are likely to cause effects on listed salmonids. NMFS also reported potential HQ exceedences to aquatic macrophytes, invertebrates and/or algae for riparian application of chlorsulfuron and metsulfuron methyl. Development of the proposed action included PDFs and buffers using results of the SERA risk assessment information to minimize the potential for herbicides to reach streams in concentrations high enough to cause these effects.

Emergent Vegetation Analysis Results

The following table shows the results of the emergent vegetation analysis developed in collaboration with NMFS. The emergent vegetation calculation indicates a low estimated maximum concentration below toxicity indices for most elements of the aquatic ecosystem (calculated concentration of imazapyr exceeded level of concern for macrophytes). Given the new information from Tierney et al. (2006), glyphosate would have an estimated Hazard Quotient of 1.5 for the Cranberry Bog. This HQ indicates risk slightly above a level of concern for sublethal effects to fish.

The Middle Hoh Floodplain Site was modeled using two different flow rates. At lower flows, glyphosate exceeded a level of concern and triclopyr approached but did not exceed a level of concern for fish and imazapyr exceeded a level of concern for algae and aquatic macrophytes. At higher flow rates (1 cubic meter per second), no exceedences for fish were calculated (slight exceedance for imazapyr for algae). However, given the new information from Tierney et al. (2006), glyphosate applied at typical rates would have an estimated Hazard Quotient of up to 5 for the Cranberry Bog.33 This indicates a risk above a level of concern for sublethal effects to fish.

Table 63-Estimated Herbicide Concentrations for the Cranberry Bog Botanical Area

Aquatic formulations	Estimated maximum concentration	Acute toxicity indices			
		Fish	Invertebrates	Algae	Macrophytes
Glyphosate	0.149 Mg/L	0.5 Mg/L (1/20th of LC50) 0.1 Tierney	78 Mg/L (1/10th of LC50)	3 Mg/L (NOEC)	3 Mg/L (NOEC)
Imazapyr	0.034 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	0.075 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)

[33] Hand/selective applications may occur at rates greater than typical, specifically, stem injection of knotweed with glyphosate may require higher concentrations to be effective. However, the potential for herbicide to be delivered to streams is minimized through the high degree of operator control exercised during selective applications.

Table 64-Estimated Herbicide Concentrations for Middle Hoh Site at Two Flows

Aquatic formulations and two different flows	Estimated maximum concentration	Acute toxicity indices			
		Fish	Invertebrates	Algae	Macrophytes
Glyphosate		0.5 Mg/L (1/20th of LC50) 0.1 (Tierney)	78 Mg/L (1/10th of LC50)	3 Mg/L (NOEC)	3 Mg/L (NOEC)
0.25 m3/sec	0.50 Mg/L				
1.0 m3/sec	0.13 Mg/L				
Imazapyr		5 Mg/L (1/20th of LC50)	100 Mg/L (NOEC)	0.02 Mg/L (1/10th of EC50)	0.013 Mg/L (EC25)
0.25 m3/sec	0.11 Mg/L				
1.0 m3/sec	0.03 Mg/L				
Triclopyr		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)
0.25 m3/sec	0.25 Mg/L				
1.0 m3/sec	0.06 Mg/L				

In the 2007 BO, NMFS displayed potential HQ values associated with emergent vegetation treatment, referred to as "Exposure from Applications within Perennial Streams." NMFS reported that "glyphosate exhibits HQ exceedances at both typical and maximum application rates…and triclopyr exhibits HQ exceedences at typical and maximum application rates." NFMS also reported "instream and gravel bar application of imazapyr can have direct lethal effects on aquatic macrophytes at both typical and maximum application rates…"

The estimated peak concentrations reported in Tables 63 and 64 above, and referenced in the NMFS BO, are unlikely to represent real life situations under Alternative B. An applicator would have to pour herbicide directly into a foot of water to approach the calculated concentration levels (direct application to water is not proposed for this project). The calculation does not incorporate local soil or weather information, nor does it integrate the behavior of the different herbicides in the environment. The emergent vegetation analysis has not been peer-reviewed and represents an extreme, unrealistic worst case scenario compared to expected field conditions.

Effects to Aquatic Species Proposed or Listed under ESA

Alternative B has a low potential to adversely affect federally listed aquatic species within the project area. Treatments are not likely to adversely affect listed fish or critical habitat because it is unlikely that herbicides would come in contact with water at amounts calculated above or of concern at treatment sites listed in Appendix A. However, the effects of herbicide treatment of aquatic emergent vegetation under EDRR cannot be entirely discounted. Refer to Table 59 for a list of treatment sites that are within 100 feet of specific anadromous fish populations.

As discussed above, treatments of emergent vegetation in small streams may disturb fish. Spot and hand herbicide applications may result in exposures, likely to be below a level of concern. The current invasive plant inventory may be treated during times of the year when fish would not be present. However, there remains uncertainty about whether fish may be present during treatments under EDRR. Thus, Alternative B is associated with the finding of "may affect" for the following federally listed aquatic species: Puget Sound steelhead, Puget Sound chinook, Hood Canal summer-run chum, and bull trout. Critical habitat for chum and chinook may also be affected.

Invasive plant treatment would have many beneficial effects on critical habitat for federally listed fish species. In the long-term, treatment of invasive weeds on the Olympic National Forest would increase riparian vegetation growth and natural successional patterns resulting in cover and food.

The potential for direct disturbance and/or herbicide exposure to federally listed fish species is low under the Proposed Action. However, the following listed species may be affected by treatments through negligible sediment and disturbance. Should emergent treatments result in worst-case predicted herbicide, individual bull trout, chum, chinook and steelhead could be adversely affected.

Chinook. Ocean-type chinook (mostly fall run) are the predominate run type on Olympic National Forest. Ocean-type Chinook are unlikely to be exposed to disturbance and herbicides from emergent vegetation treatments because the fry migrate to salt water shortly after emerging in the spring. Stream-type chinook overwinter in fresh water, typically migrating to the ocean the following spring. Treatments of emergent vegetation may result in short term disturbance or limited herbicide exposure to stream-type chinook.

Chum. Summer, fall, and winter chum fry emerge from gravels in March and April, and quickly outmigrate to the estuary for rearing. Invasive plant treatment during this period is not likely to impact chum because emergent vegetation treatments are not extensive enough to impact outmigrating juveniles.

Steelhead Trout. Treatment of emergent vegetation in small streams could disturb juvenile steelhead. Herbicide exposure is not likely to exceed a level of concern for fish; however there is uncertainty about herbicide exposure from treatment of emergent vegetation.

Bull Trout. Bull trout fry are more susceptible to impacts from invasive plant treatments during the spring because of the potential for disturbance and loss of vegetative cover.

Potential impacts to juvenile bull trout as a result of non-lethal herbicide exposure are not known. There is uncertainty about herbicide exposure from treatment of emergent vegetation.

The FWS reported that the protective riparian buffers, minimization measures, and restricted application methods will prevent herbicides from causing incidental take of bull trout under most treatment scenarios. However, some treatment actions may cause incidental take of bull trout. The incidental take is expected to be in the form of non-lethal harm, caused by short-term exposures of bull trout to sub-lethal concentrations of herbicides and associated compounds. Sub-lethal effects include short-term impairments (hours) of normal functions and behaviors such as olfaction, respiration, and feeding. These effects may occur as a result of herbicide applications (e.g., emergent vegetation treatments, riparian applications, or applications in roadside ditches and intermittent streams which connect directly to bull trout rearing habitat). Herbicides proposed for use by the ONF are not expected to reach streams in concentrations that would kill bull trout (FWS 2007 BO).

Effects on Designated Critical Habitat

In 1996, NMFS developed a methodology for making ESA determinations for individual or grouped activities at the watershed scale, termed the "Habitat Approach". A Matrix of Pathways and Indicators (MPI) was recommended under the Habitat Approach to assist with analyzing effects to listed species. The MPI was used by Olympic National Forest in previous years to analyze project effects on listed fish species. When using the MPI, project effects to the Pathways (significant pathways by which actions can have potential effects on anadromous salmonids and their habitats) and Indicators (numeric ratings or narrative descriptors for each Pathway) are used to determine whether proposed actions would damage habitat or retard the progress of habitat recovering towards properly functioning condition.

Table 65 displays a "cross-walk" between the MPI Indicators and PCE's of the Sept. 2, 2005 designated critical habitat used to assess effects on designated critical habitat. Section 3.4 of this Chapter contains additional information on potential effects to specific physical parameters.

Table 65-Pathway, Indicator, and PCE Crosswalk

Comment [js2]: My opinon, I would look at making this landscape.

	Analysis of PCE Relative To Alternative B
Pathway: Water Quality Indicator: Temperature PCE Crosswalk: Spawning, Rearing, Migration Habitat	Removal of invasive plants along small streams may increase solar radiation at a localized level (i.e. on a small portion of a stream) where invasive plants are the only source of shade. The precise effects to water temperature from treating invasive plants will depend on the size of the stream, how close to the stream a treatment site is, how much is treated along the stream, and what vegetation is currently available to shade the stream. A significant amount of vegetation would need to be removed to change water temperature in the stream, and shade would have to be provided only by the invasive plant removed – a situation that is not likely on Olympic National Forest. Many of the treatment sites in previously disturbed areas requiring herbicide use had riparian harvest or other ground disturbing activities (i.e. flood) that removed most of trees that provided stream shade. This implies that the greatest changes to water temperature may have already taken place. One reason treatment of invasive plants is being proposed is to recover stand structure and, in time, provide more stream shade with the establishment of native coniferous and deciduous trees. The PDFs prohibits broadcast applications within 100 ft. of wet perennial and intermittent waterbodies, and along roads that have a high likelihood of delivering herbicides to streams in order to prevent any potential adverse affects to stream channels or water quality conditions. This PDF will protect overhanging vegetation and smaller trees that are currently providing shade closest to the stream and other waterbodies. The treatment of invasive plants with broadcast applications outside of the 100 ft buffer should have little affect on stream temperature because the invasive plants treated would be no taller than the ones left within the buffered area. Spot-spray applications would not be large enough to impact enough vegetation influencing water temperature. Any short term impacts occurring from loss of small shade provided by invasive plants at the treatment site would not elicit an effect and would far outweigh the long term benefits of the restored and increased growth of native riparian vegetation, specifically coniferous and deciduous trees.
Pathway: Water Quality Indicator: Sediment/Turbidity PCE Crosswalk: Spawning habitat	Treatment of invasive plants has a low probability for producing sediment because very little ground disturbance will take place when invasive plants are treated with spot-spray or hand applications. If sediment is produced, it would be as a result of heavy manual labor related to uprooting invasive plants or excessive trampling along streambanks. Manual labor such as hand pulling to control invasive plants may result in localized soil disturbance, but increases of sediment to streams would likely be undetectable. Not all vegetation in a treated area would be pulled or removed, so some ground cover plants would remain. Not all sediment from pulling weeds along roads would reach a stream because many relief culverts intercept ditch flow and drain it on to the forest floor away from streams. Handpulling is very labor intensive and costly. Thus, only a few acreas per year could be treated using this technique across a watershed. When compared to the total acres within a watershed, project-related soil disturbance from handpulling would be negligible.
Pathway: Channel Condition & Dynamics Indicator: Floodplain Connectivity PCE Crosswalk: Rearing habitat	Some invasive plant treatments can have positive effects on floodplains and streambanks when infestations of invasive plants on valley bottom areas are removed. Valley-bottom infestations often encroach on floodplains where road-related and recreational activities have led to the establishment of invasive plant populations. Removal of such infestations is expected to benefit aquatic and terrestrial communities in the long term by increasing floodplain area available for nutrient, sediment and large wood storage, and flood flow refugia. There is no risk of negatively impacting channel condition and dynamics as a result of treating invasive plants.
Pathway: Habitat Access Indicator: Physical Barriers PCE Crosswalk: Migration habitat	Invasive plant treatments will not create physical barriers or otherwise degrade access to aquatic habitat. On the contrary, where blackberries have been established along streambanks, lack of treatment may result in the increase of their root system which could cross the stream channel resulting in an aggaded channel blocking fish access during low flow.
Pathway: Habitat Elements Indicator: Substrate/Sediment PCE Crosswalk: Spawning, Rearing habitat	Invasive plant treatmetns is not expected to affect substrate composition. All PDFs that minimize sediment would be implemented, such as no heavy equipment within riparian areas. These practices would reduce, but not eliminate sediment. Some sediment may enter stream channels as a result of extensive manual labor and could result in exposed soils. The amount of sediment that enters a stream is expected to be small, infrequent, short duration, and at a localized level. Short- term effects such as localized increases in fine sediment in gravels or along channel margins may be seen at the immediate treatment site. However, substrate quality would not decrease over time because treatment of invasive plants would not result in a chronic sediment source.

	Analysis of PCE Relative To Alternative B
Pathway: Habitat Elements Indicator: Large Woody Debris, and Pool Area, Quality and Frequency PCE Crosswalk: Spawning habitat	Treatment of invasive plants would not impact pool area, quality and frequency. Treatment of invasive plants in riparian reserves would not impact current wood debris in streams. The PDF that establishes a 100 ft buffer for broadcast applications provides protection to the recruitment of conifer seedlings within riparian areas which will sustain channel and habitat features in the future. With the treatment of invasive plants, riparian stands in time would develop larger recruitment trees and would increase the size of inchannel debris. The use of spot-spray applications of aquatic glyphosate and aquatic imazapyr may result in some minor non-target vegetation impact because of drift. However, the amount necessary to drift into the entire riparian area and kill trees is not possible with spot-spray applications.
Pathway: Flow/Hydrology Indicator: Change in Peak/Base Flows PCE Crosswalk: Spawning, Rearing, Migration habitat	Hydrologic changes from invasive plant treatments would never be large enough to cause effects at a subwatershed scale. There is no risk of increasing water yield at the subwatershed scale as a result of treating invasive plants. The only negative effect on designated critical habitat would result from the short term, localized increases in turbidity and sedimentation due to people implementing non-herbicide treatment methods along the waters edge. As previously discussed, the levels of fine sediment and turbidity increases at the project scale are expected to be insignificant and discountable, a one time event, and short-term. Any fines as a result of non-herbicide treatment methods are expected to be washed out by the end of the high flow period. However, the majority of fine sediment deposition is expected to be deposited in low-velocity areas including the pool tail crest regions on top of LCR chinook redds in the lower reaches of watersheds. However, the small increase in fine sediment does not have a negative effect on any PCE of critical habitat. All spawning gravel in the action area, including the pool tail crest regions, is expected to be usable for the next LCR chinook and LCR coho fall spawning. The potential for increased erosion into aquatic areas as a result of removing the protective cover and rooting along streambanks or waterbodies is reduced by establishing a 50' buffer for broadcast sprays of aquatic labeled herbicides. The 50' buffer along waterbodies was established to avoid the potential for some erosion that could occur, at least in the short term, from the use of aquatic labeled glyphosate and aquatic labeled imazapyr (known to be non-selective) as a result of killing both weeds and native vegetation. Broadcast spray of aquatic labeled triclopyr is not allowed.

Effects on Essential Fish Habitat

Non-herbicide treatment methods would have localized effects to habitat indicators for Essential Fish Habitat (EFH) at the project scale. Herbicide treatment methods may result in insignificant amounts of herbicides coming in contact with water as a result of drift and runoff from roadside ditches. Effects from both non-herbicide and herbicide treatment methods would be insignificant and discountable under Alternative B because of PDFs and established buffers along perennial and intermittent streams, and roads that have the potential to deliver herbicides to waterbodies. As discussed above under direct and indirect effects from herbicide and non-herbicide treatment methods, EFH for Chinook, coho, and pink salmon would not be adversely affected.

Effects to Regional Forester's Sensitive Fish Species

Alternative B is associated with a finding of "may impact individuals but not likely contribute to a trend towards federal listing or loss of viability to their population or species" for the following sensitive aquatic species: Coho salmon, Lake Quinault sockeye salmon, Olympic mudminnow, Salish sucker, Puget Sound coastal cutthroat trout, and Olympic Peninsula coastal cutthroat trout.[34] The "may effect" finding is because non-herbicide and herbicide treatments within the scope of this project could result in small scale, localized disturbance to fish and other aquatic organisms.

Under Alternative B, aquatic organisms may be exposed to herbicides used to treat riparian (especially emergent target vegetation) have the potential to result in herbicide exposure to fish and the aquatic ecosystem. Treatments may result in loss of individual non-target plants within the riparian zone; however, treatments would not be extensive enough to substantially alter fish habitats.

[34] There would be no effect on Lake Pleasant sockeye salmon because treatments on National Forest would be over 2.5 miles from its habitat.

Adverse effects would be minimal because 1) wetland treatments are limited to 6 acres per year per 6th field watershed; 2) wetland treatments are limited to hand or spot treatments with a limited herbicide selection and 3) the infested areas are scattered across long roadside distances and are not concentrated in any one area. Site-specific modeling for emergent vegetation treatments indicate exposures would be below any level of concern for fish. Disturbance would not persist and vegetation impacts would not last more than a season or two. There would be a long-term benefit from restoration of native plants.

The potential for disturbance and/or herbicide exposure to sensitive fish species is described below. Please see "Effects to Aquatic Species Proposed or Listed under ESA" above for Washington Coast Chinook, Puget Sound/Straight of Georgia Chum, and Pacific Coast Chum.

Coho salmon. Spot and hand/selective herbicide treatments could occur along side channels or ponds while juvenile coho are rearing. However, there is low potential for herbicide exposure above a level of concern to coho. Non-lethal effects of low-level exposure to juvenile fish is not well understood.

Sockeye Salmon. The treatment of emergent or shoreline knotweed or other invasive plants may impact individual Lake Quinault sockeye. Sockeye spawns in shallow gravelly areas in rivers and lakes, thus may be disturbed or displaced by treatments near the lake shore. Herbicide use is proposed along the lakeshore according to PDFs and buffers. Spot and hand applications of aquatic labeled herbicides are proposed near the lake shoreline However the extent of treatment is small and sockeye food source and habitat would not be altered.

Olympic Mudminnow. There are no treatment sites that include known locations of Olympic mudminnows. Under EDRR, slow moving wetlands and wet road ditches that provide mudminnow habitat may be treated. PDF H14 limits the extent of emergent invasive plant treatment to six acres per 6th field watershed per year. This restriction ensures that treatments would not impact a large area of mudminnow habitat.

In addition, no broadcasting would occur near wet ditches or wetlands. Herbicide use is limited to aquatic labeled and lower aquatic risk herbicides.

Salish Sucker. Invasive plants currently grow along the shore of Lake Cushman, home of the Salish sucker. Overhanging target vegetation may provide cover, so a short term loss of cover may occur if the target vegetation is removed or killed. This effect would be limited in extent and native vegetation would likely replace the cover within a season or two. Adverse impacts would be short-term an limited in extent given PDF H10.

Coastal cutthroat trout. Herbicides would not be applied during peak spawning periods because these occur in winter and invasive plant treatments do not occur this time of year. Some disturbance and loss of individual non-target plants could occur in smaller streams. The extent of treatment areas along stream margins containing coastal cutthroat trout would be small compared to the available habitat for this species.

Early Detection Rapid Response

Treating emergent vegetation in a wetland or within the bankfull portion of a small stream may result in herbicide exposure to aquatic organisms. Treating emergent invasive vegetation during spawning and/or when redds are present could result in disturbance and/or herbicide exposure to fish. Although activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds, a worker may displace a spawning fish or step on a redd. Uncertainty about the location and extent of treatment is addressed through PDFs and buffers. However, the uncertainty inherent in EDRR results in an ESA effects determination of Likely to Adversely Affect for some SOLI (see Table 68).

Cumulative Effects

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 offsite or off-target herbicide spread are not known, the agencies presumed that the programs do not have prevention measures similar to the

ONF. 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 ONF 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. In addition, 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 (NMFS 2007 BO).

For all known infestations considered in the analysis. PDFs and buffers reduce the potential for herbicide to reach a level of concern at any scale. There would be no potential for herbicide to accumulate with use downstream and reach a threshold of concern. This is because the amount of treatment proposed compared to the size of the watershed and extent of the aquatic ecosystem is very low and effects to habitat are likely to be negligible.

Treatment of emergent vegetation under EDRR is associated with some uncertainty that herbicide may enter streams and affect fish habitat or an individual fish. The cumulative effects of other pesticide use downstream of the Olympic National Forest enhances the exposure risks to both juvenile and adult fish, and brings in the factor of pesticide mixtures, further adding to the potential for sublethal effects. While it is reasonably certain that individual PSC will express impaired normal behavioral patterns, be injured, or suffer ecological death, these outcomes will be limited because exposures will be intermittent, based on the proposed action and PDFs and 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 (ibid).

To deal with the issue of invasive species in the region, the ONF expects 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 within all counties. It is expected that the counties will work with ONF and ONP cooperatively to control invasive plants. If agreements are established with counties for noxious weed control outside of the boundaries of the ONF, FS standards will be incorporated into those agreements (ibid).

FWS 2007 BO reported that non-federal actions that could affect bull trout are reasonably certain to occur within the action area. These actions include residential development, road management, small-scale agriculture, and bank stabilization projects. FWS found that the effects to bull trout associated with these actions would be limited and widely dispersed.

Alternative C

Alternative C eliminates most use of herbicides in Riparian Reserves (twice the size of the Aquatic Influence Zone); eliminates use of herbicides within roadside treatment areas having high potential for herbicide delivery, and does not allow any broadcast of any herbicide in any situation. No direct or indirect effects on fish and other aquatic organisms from herbicide use would be anticipated; effects would be similar to No Action regards herbicide use.

The PDFs for Alternative C completely eliminate concerns related to herbicide use. Non-herbicide methods would be favored, so more disturbance from manual crews or mechanical equipment would be likely. However, even under the most ambitious conceivable program, effects on aquatic organisms from non-herbicide treatments would be similar to the Proposed Action. The increased manual/mechanical acreage, treated according to PDFs, would not trigger any threshold of concern. This is true for known sites as well as new sites detected in the future.

SERA Worksheets and Emergent Vegetation Calculation

The SERA Worksheet and Emergent Vegetation Analysis was not conducted for Alternative C because the herbicide use currently approved does not result in herbicide delivery to streams.

Effects to Aquatic Species Proposed or Listed under ESA and Critical Habitat

Alternative C may have beneficial effects on critical habitat for federally listed fish species. It would be difficult in the long-term to effectively eradicate or control invasive weeds on Olympic National Forest that are currently posing threats to the growth of native vegetation along intermittent streams and/or roadside treatment areas that have high potential to deliver herbicide. Because intermittent streams are associated with debris flows, where most large wood and spawning gravel is delivered, invasion of weeds can interrupt natural patterns of debris flows if invasions are extensive enough.

Alternative C is not likely to adversely affect proposed or listed fish, nor their habitat. Minor ground disturbance may result in small amounts of sediment to enter streams but this is unlikely to be extensive enough to affect critical habitat.

Effects on Designated Critical Habitat

Table 66 below displays the analysis of Primary Constituent Elements of Critical Habitat for Alternative C.

Table 66-Alternative C, PCEs of Critical Habitat

Pathway, Indicator, and PCE Crosswalk	Analysis of PCE Relative To Alternative C
Pathway: Water Quality Indicator: Temperature PCE Crosswalk: Spawning, Rearing, Migration Habitat	Removal of invasive plants along small streams may increase solar radiation at a localized level (i.e. on a small portion of a stream) where invasive plants are the only source of shade. The precise effects to water temperature from treating invasive plants will depend on the size of the stream, how close to the stream a treatment site is, how much is treated along the stream, and what vegetation is currently available to shade the stream. A significant amount of vegetation would need to be removed to change water temperature in the stream, and shade would have to be provided only by the invasive plant removed – a situation that is not likely on Olympic National Forest. Many of the treatment sites in previously disturbed areas requiring herbicide use had riparian harvest or other ground disturbing activities (i.e. flood) that removed most of trees that provided stream shade. This implies that the greatest changes to water temperature may have already taken place. One reason treatment of invasive plants is being proposed is to recover stand structure and, in time, provide more stream shade with the establishment of native coniferous and deciduous trees.
Pathway: Water Quality Indicator: Sediment/Turbidity PCE Crosswalk: Spawning habitat	Alternative C has a low probability for producing sediment as a result of heavy manual labor related to uprooting invasive plants or excessive trampling along streambanks. Manual labor such as hand pulling to control invasive plants may result in localized soil disturbance, but increases of sediment to streams would likely be undetectable. Not all vegetation in a treated area would be pulled or removed, so some ground cover plants would remain. Not all sediment from pulling weeds along roads would reach a stream because many relief culverts intercept ditch flow and drain it on to the forest floor away from streams. Handpulling is very labor intensive and costly. Thus, only a few acreas per year could be treated using this technique across a watershed. When compared to the total acres within a watershed, project-related soil disturbance from handpulling would be negligible.
Pathway: Channel Condition & Dynamics Indicator: Floodplain Connectivity PCE Crosswalk: Rearing habitat	Some invasive plant treatments can have positive effects on floodplains and streambanks when infestations of invasive plants on valley bottom areas are removed. Valley-bottom infestations often encroach on floodplains where road-related and recreational activities have led to the establishment of invasive plant populations. Removal of such infestations is expected to benefit aquatic and terrestrial communities in the long term by increasing floodplain area available for nutrient, sediment and large wood storage, and flood flow refugia. There is no risk of negatively impacting channel condition and dynamics as a result of treating invasive plants.
Pathway: Habitat Access Indicator: Physical Barriers PCE Crosswalk: Migration habitat	Invasive plant treatments will not create physical barriers or otherwise degrade access to aquatic habitat. On the contrary, where blackberries have been established along streambanks, lack of treatment may result in the increase of their root system which could cross the stream channel resulting in an aggaded channel blocking fish access during low flow.

Pathway, Indicator, and PCE Crosswalk	Analysis of PCE Relative To Alternative C
Pathway: Habitat Elements Indicator: Substrate/Sediment PCE Crosswalk: Spawning, Rearing habitat	Invasive plant treatmetns is not expected to affect substrate composition. All PDFs that minimize sediment would be implemented, such as no heavy equipment within riparian areas. These practices would reduce, but not eliminate sediment. Some sediment may enter stream channels as a result of extensive manual labor and could result in exposed soils. The amount of sediment that enters a stream is expected to be small, infrequent, short duration, and at a localized level. Short- term effects such as localized increases in fine sediment in gravels or along channel margins may be seen at the immediate treatment site. However, substrate quality would not decrease over time because treatment of invasive plants would not result in a chronic sediment source.
Pathway: Habitat Elements Indicator: Large Woody Debris, and Pool Area, Quality and Frequency PCE Crosswalk: Spawning habitat	Treatment of invasive plants would not impact pool area, quality and frequency. Treatment of invasive plants in riparian reserves would not impact current wood debris in streams. With the treatment of invasive plants, riparian stands in time would develop larger recruitment trees and would increase the size of inchannel debris.

Effects on Essential Fish Habitat (EFH)

Non-herbicide treatments under Alternative C would have localized effects to habitat indicators for EFH at the project scale. Because herbicide treatment methods are not allowed in riparian areas, there will be more reliance on non-herbicide treatment methods. The use of non-herbicide treatment methods may result in increased sediment at the project scale, however, it is unlikely that it would lead to an adverse affect because perennial streams remain buffered and the likelihood of significant amounts of sediment being delivered to fish-bearing streams is extremely low. As discussed above under direct and indirect effects from herbicide and non-herbicide treatment methods, EFH for Chinook, coho, and pink salmon would not be adversely affected under Alternative C.

Effects to Regional Forester's Sensitive Fish Species

Alternative C avoids all herbicide use near sensitive fish species and their habitat. Thus, there would be no potential impact from herbicide. However, manual and mechanical treatments may result in disturbance to individual fish. Such disturbance would be limited in extent and of short duration.

Sediment delivery from non-herbicide treatments is not likely to be significant. Passive and active restoration of native vegetation would be a long term benefit to sensitive fish.

Early Detection and Rapid Response

The effects to the aquatic environment from treating unknown future populations would be similar to the effects of treating the known inventory. PDFs would be applied and non-herbicide methods would continue within Riparian Reserves and along higher risk road segments. Non-herbicide treatments of aquatic emergent vegetation could result in short-lived, localized disturbance to redds. Such disturbances may be more frequent in Alternative C than the Proposed Action due to the lack of treatment effectiveness and presumable increased need for repeated treatments. However, none of the treatments in Alternative C are likely to adversely impact listed species (see Table 68).

Cumulative Effects

The lack of potential significant adverse direct and indirect effects from treatments under Alternative C reduces the potential for cumulative effects, even when this project is considered with other past, present and future projects. No herbicide would be delivered to area streams, so none could accumulate with others' use. Sediment from minor ground disturbance would be so small as to be negligible and would not contribute to accumulation of downstream sediment.

Alternative D

Alternative D has a higher probability of adverse effects than the other alternatives due to greater likelihood that broadcast treatments or higher risk herbicides would be used along dry intermittent streams and roadside treatment areas with high potential to deliver herbicide. Label directions would still need to be followed relative to herbicide application near any surface waters. Alternative D adopts similar PDFs as the Proposed Action to avoid harm to soil, water and aquatic organisms.

However, herbicides coming in contact with water could kill aquatic vegetation, especially from broadcast treatments across intermittent streams and along roadside ditches. The worst case scenario would involve broadcast spraying of a higher risk herbicide along a road that has a high potential of delivering herbicides to streams with fish and other aquatic organisms. A storm soon after herbicide application could wash herbicide into streams and result in concentrations exceeding levels of concern for fish and other aquatic organisms. Localized, short-term adverse effects to aquatic plants from use of herbicide in this situation would be possible under this alternative. This would be localized and not likely to result in significant adverse effects to the aquatic ecosystem. However, as discussed under Alternative B, effects to fish cannot be entirely discounted. Risks are similar to Alternative B, although greater due to the lack of restrictions on roads with high potential to deliver herbicide to streams and dry streams.

SERA Worksheets and Emergent Vegetation Calculation

The SERA Worksheet and Emergent Vegetation Calculation discussed under Alternative B above also applies to Alternative D. These models are not sensitive to the differences between the two alternatives.

To the extent that Alternative D allows more broadcast treatment, it more closely reflects the SERA Worksheet assumptions and findings for the Proposed Action in the BA and BOs. However, Alternative D includes PDFs and buffers for wetlands and wet streams, thus herbicide concentrations in water approaching the modeled results would be unlikely.

Effects on Species Proposed or Listed under the Endangered Species Act

Alternative D may have similar beneficial effects on critical habitat for federally listed fish species as Alternative B but would have greater likelihood of herbicide reaching level of concern for aquatic organisms. In particular, summer run chum and Puget Sound chinook are more likely to be adversely affected by Alternative D because of the potential effects on aquatic plants from broadcast treatment along roadside ditches and dry streams.

Effects on Designated Critical Habitat

Table 67 below displays the analysis of Primary Constituent Elements of Critical Habitat for Alternative D.

Table 67-Alternative D, PCEs of Critical Habitat

Pathway, Indicator, and PCE Crosswalk	Analysis of PCE Relative To Alternative D
Pathway: Water Quality Indicator: Temperature PCE Crosswalk: Spawning, Rearing, Migration Habitat	Removal of invasive plants along small streams may increase solar radiation at a localized level (i.e. on a small portion of a stream) where invasive plants are the only source of shade. The precise effects to water temperature from treating invasive plants will depend on the size of the stream, how close to the stream a treatment site is, how much is treated along the stream, and what vegetation is currently available to shade the stream. A significant amount of vegetation would need to be removed to change water temperature in the stream, and shade would have to be provided only by the invasive plant removed – a situation that is not likely on Olympic National Forest. Many of the treatment sites in previously disturbed areas requiring herbicide use had riparian harvest or other ground disturbing activities (i.e. flood) that removed most of trees that provided stream shade. This implies that the greatest changes to water temperature may have already taken place. Under Alternative D, there would be no PDF prohibiting broadcast applications near dry streams or along roads that have a high likelihood of delivering herbicides to streams. However, any short term impacts occurring from loss of small shade provided by invasive plants at the treatment site would not elicit an effect and would far outweigh the long term benefits of the restored and increased growth of native riparian vegetation, specifically coniferous and deciduous trees.
Pathway: Water Quality Indicator: Sediment/Turbidity PCE Crosswalk: Spawning habitat	Treatment of invasive plants has a low probability for producing sediment because very little ground disturbance will take place when invasive plants are treated with spot-spray or hand applications. If sediment is produced, it would be as a result of heavy manual labor related to uprooting invasive plants or excessive trampling along streambanks. Manual labor such as hand pulling to control invasive plants may result in localized soil disturbance, but increases of sediment to streams would likely be undetectable. Not all vegetation in a treated area would be pulled or removed, so some ground cover plants would remain. Not all sediment from pulling weeds along roads would reach a stream because many relief culverts intercept ditch flow and drain it on to the forest floor away from streams. Handpulling is very labor intensive and costly. Thus, only a few acreas per year could be treated using this technique across a watershed. When compared to the total acres within a watershed, project-related soil disturbance from handpulling would be negligible.
Pathway: Channel Condition & Dynamics Indicator: Floodplain Connectivity PCE Crosswalk: Rearing habitat	Some invasive plant treatments can have positive effects on floodplains and streambanks when infestations of invasive plants on valley bottom areas are removed. Valley-bottom infestations often encroach on floodplains where road-related and recreational activities have led to the establishment of invasive plant populations. Removal of such infestations is expected to benefit aquatic and terrestrial communities in the long term by increasing floodplain area available for nutrient, sediment and large wood storage, and flood flow refugia. There is no risk of negatively impacting channel condition and dynamics as a result of treating invasive plants.
Pathway: Habitat Access Indicator: Physical Barriers PCE Crosswalk: Migration habitat	Invasive plant treatments will not create physical barriers or otherwise degrade access to aquatic habitat. On the contrary, where blackberries have been established along streambanks, lack of treatment may result in the increase of their root system which could cross the stream channel resulting in an aggaded channel blocking fish access during low flow.
Pathway: Habitat Elements Indicator: Substrate/Sediment PCE Crosswalk: Spawning, Rearing habitat	Invasive plant treatmetns is not expected to affect substrate composition. All PDFs that minimize sediment would be implemented, such as no heavy equipment within riparian areas. These practices would reduce, but not eliminate sediment. Some sediment may enter stream channels as a result of extensive manual labor and could result in exposed soils. The amount of sediment that enters a stream is expected to be small, infrequent, short duration, and at a localized level. Short- term effects such as localized increases in fine sediment in gravels or along channel margins may be seen at the immediate treatment site. However, substrate quality would not decrease over time because treatment of invasive plants would not result in a chronic sediment source.
Pathway: Habitat Elements Indicator: Large Woody Debris, and Pool Area, Quality and Frequency PCE Crosswalk: Spawning habitat	Treatment of invasive plants would not impact pool area, quality and frequency. Treatment of invasive plants in riparian reserves would not impact current wood debris in streams. With the treatment of invasive plants, riparian stands in time would develop larger recruitment trees and would increase the size of inchannel debris. Some minor non-target vegetation impact may occur because of drift. However, the amount necessary to drift into the entire riparian area and kill trees is unlikely.

Pathway, Indicator, and PCE Crosswalk	Analysis of PCE Relative To Alternative D
Pathway: Flow/Hydrology Indicator: Change in Peak/Base Flows PCE Crosswalk: Spawning, Rearing, Migration habitat	Hydrologic changes from invasive plant treatments would never be large enough to cause effects at a subwatershed scale. There is no risk of increasing water yield at the subwatershed scale as a result of treating invasive plants. The only negative effect on designated critical habitat would result from the short term, localized increases in turbidity and sedimentation due to people implementing non-herbicide treatment methods along the waters edge. As previously discussed, the levels of fine sediment and turbidity increases at the project scale are expected to be insignificant and discountable, a one time event, and short-term. Any fines as a result of non-herbicide treatment methods are expected to be washed out by the end of the high flow period. However, the majority of fine sediment deposition is expected to be deposited in low-velocity areas including the pool tail crest regions on top of LCR chinook redds in the lower reaches of watersheds. However, the small increase in fine sediment does not have a negative effect on any PCE of critical habitat. All spawning gravel in the action area, including the pool tail crest regions, is expected to be usable for the next LCR chinook and LCR coho fall spawning. The potential for increased erosion into aquatic areas as a result of removing the protective cover and rooting along streambanks or waterbodies is reduced by establishing a 50' buffer for broadcast sprays of aquatic labeled herbicides. The 50' buffer along waterbodies was established to avoid the potential for some erosion that could occur, at least in the short term, from the use of aquatic labeled glyphosate and aquatic labeled imazapyr (known to be non-selective) as a result of killing both weeds and native vegetation. Broadcast spray of aquatic labeled triclopyr is not allowed.

See table 67 for ESA determinations for critical habitat

Effects on Essential Fish Habitat (EFH)

Non-herbicide treatments would have localized effects to habitat indicators for EFH at the project scale. Herbicide treatment methods may result in a certain amount of herbicides coming in contact with water as a result of drift and runoff from roadside ditches and intermittent streams. Although amounts may not be toxic to adult fish, water contamination does have an influence on quality of habitat, impacting EFH to some extent because some vegetation may die. Effects from both non-herbicide and herbicide treatment methods would be insignificant, however under EFH definitions and criteria there could be an adverse affect to water necessary for chinook and coho yolk-sac fry. Thus, EFH for Chinook, coho, and pink salmon would be adversely affected under Alternative D.

Herbicide use as designed under Alternative D might not comply with water quality standards, given that glyphosate, picloram and triclopyr may harm aquatic organisms at concentrations modeled assuming average parameters for broadcast near streams (based on analysis in the R6 2005 FEIS). Such use may occur near dry streams in Alternative D.

The patchy distribution of invasive plants would serve to limit the risk, but under worst-case scenarios herbicides may adversely affect fish and other aquatic organisms. Effects from use of herbicide on wetland emergent target vegetation would be similar to the Proposed Action. However, Alternative D is associated with a much greater level of risk assuming an unexpected storm followed broadcast treatment of high or moderate risk herbicides in or near dry intermittent streams, and within roadside treatment areas having high risk of herbicide delivery. Herbicide treatments in this situation under Alternative D are likely to adversely affect fish species of local interest.

For Alternative D to comply with standards, additional Project Design Features would have to be adopted for dry intermittent streams and roadside treatment areas having a high potential for herbicide delivery, including restrictions on use or application methods approved for herbicides of moderate or greater concerns to aquatic organisms.

Effects to Aquatic Species on Regional Forester's Sensitive Species List

Alternative D would have similar effects on sensitive species as Alternative B. Mudminnow that use roadside ditch habitats are more likely to be exposed to broadcast in this alternative under EDRR, but no known mudminnow areas would be affected. Small amounts of herbicides coming in contact with water would not necessarily adversely affect adult fish, but could have a negative effect on juveniles or their habitat.

Early Detection and Rapid Response

Treating emergent vegetation in a wetland or within the bankfull portion of a small stream may result in herbicide exposure to aquatic organisms. Treating emergent invasive vegetation during spawning and/or when redds are present could result in disturbance and/or herbicide exposure to fish. Although activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds, a worker may displace a spawning fish or step on a redd. Uncertainty about the location and extent of treatment is addressed through PDFs and buffers. However, the uncertainty inherent in EDRR results in an ESA effects determination of Likely to Adversely Affect for some SOLI (see Table 68).

Cumulative Effects

Alternative D is associated with a much greater level of risk assuming an unexpected storm followed broadcast treatment of high or moderate risk herbicides in or near dry intermittent streams and within roadside treatment areas having high risk of herbicide delivery. However, there would be low potential for herbicide to accumulate with use downstream and reach a threshold of concern because the amount of treatment proposed compared to the size of the watershed and extent of the aquatic ecosystem is low.

Treatment of riparian and emergent vegetation under EDRR is associated with some uncertainty that herbicide may enter streams and affect fish habitat or an individual fish. However, the potential for cumulative effects would still be low because the extent of riparian vegetation treatment, even under EDRR, is limited to 6 acres below bankfull and/or 10 acres above bankfull per 1.5 mile of stream in a 6th field watershed per year. This reduces the potential for significant amounts of herbicide to accumulate downstream. However, other pesticide use downstream of the Olympic National Forest enhances the exposure risks to both juvenile and adult PSS, and brings in the factor of pesticide mixtures, further adding to the potential for sublethal effects (NMFS 2007 BO).

Alternative Comparison

Table 68-Effects to Aquatic Organisms Alternative Comparison

	No Action (A)	Proposed Action (B)	Alternative C	Alternative D
Potential for fish to be exposed to harmful concentrations of herbicide	Very Low	Low	Very Low	Moderate to High
Species	**Findings and Determinations for Listed Species and Critical Habitat**			
Puget Sound Steelhead	No Effect Minor ground mainly disturbance limited to upland acres, very small amount of stem injection	LAA Uncertainty related to herbicide use under EDRR for emergent vegetation. Sediment and disturbance same as other action alternatives	NLAA Negligible sediment and disturbance	LAA Greater likelihood of herbicide reaching level of concern for aquatic organisms.
Puget Sound Chinook	No Effect Minor ground disturbance limited to upland acres	LAA Uncertainty related to herbicide use under EDRR for emergent vegetation. Sediment and disturbance same as other alternatives	NLAA Negligible sediment and disturbance	LAA Greater likelihood of herbicide reaching level of concern for aquatic organisms.
Critical Habitat for Puget Sound Chinook	No Effect Minor ground disturbance limited to upland acres	NLAA Negligible sediment and disturbance; low potential for individual aquatic plants to die as a result of herbicide .	NLAA Negligible sediment and disturbance	LAA Greater likelihood of herbicide reaching level of concern for aquatic organisms.
Hood Canal Summer-run Chum	No Effect Minor ground disturbance limited to upland acres	LAA Uncertainty related to herbicide use under EDRR for emergent vegetation. Sediment and disturbance same as other alternatives	NLAA Negligible sediment and disturbance	LAA Greater likelihood of herbicide reaching level of concern for aquatic organisms.
Critical Habitat for Hood Canal Summer-run Chum	No Effect Minor ground disturbance limited to upland acres	NLAA Negligible sediment and disturbance; low potential for individual aquatic plants to die as a result of herbicide .	NLAA Negligible sediment and disturbance	LAA Greater likelihood of herbicide reaching level of concern for aquatic organisms.
Coastal Puget Sound Bull Trout	No Effect Minor ground disturbance limited to upland acres	LAA Uncertainty related to herbicide use under EDRR for emergent vegetation. Sediment and disturbance same as other alternatives	NLAA Negligible sediment and disturbance	LAA Likelihood of herbicide reaching some level of concern for aquatic organisms.
Critical Habitat for Coastal Puget Sound Bull Trout	No Effect No delivery of herbicide or sediment expected downstream off National Forest lands	No Effect Herbicide or sediment that entered stream would be below any threshold of concern by the time it reached critical habitat.	Same as Proposed Action	Same as Proposed Action

3.6 Effects of Herbicide Use on Workers and The Public

3.6.1 Introduction

The effect of herbicides on human health is a primary public issue (Issue Group 1). This section focuses on plausible effects to workers and the public from herbicide exposure. The R6 2005 FEIS evaluated human health risks from herbicide and non-herbicide invasive plant treatment methods. Hazards normally encountered while working in the woods (strains, sprains, falls, etc) are possible during herbicide and non-herbicide invasive plant treatment operations. Such hazards are mitigated through worker compliance with occupational health and safety standards and are not a key issue for this project-level analysis.

Many people express concern about the effects of herbicides on human heath. Workers and the public may be exposed to herbicides used to treat invasive plants under all alternatives in this project; however no exposures exceeding a threshold of concern are predicted. This conclusion is based on facts about chemistry of the herbicides considered for use and the mechanisms by which exposures of concern might occur.

The R6 2005 FEIS considered potential hazards to human health from herbicide active ingredients, metabolites, inert ingredients, and adjuvants. As a result, the R6 2005 ROD standards were adopted to minimize herbicide exposures of concern to workers and the public. Site-specific Project Design Features (PDFs) were developed to further minimize or eliminate exposures of concern to workers and the public plausible given the regional standards. The PDFs ensure that herbicides and surfactants are used in rates low enough, or methods selective enough, to avoid exposures of concern.

The R6 2005 FEIS relied on professional risk assessments completed Syracuse Environmental Research Associates, Inc (SERA) using peer-reviewed articles from the open scientific literature and current EPA documents, including Confidential Business Information.

The SERA Risk Assessment full citations are listed in Chapter 3.1.5. Appendix Q of the R6 2005 FEIS provides detailed information about the human health hazards associated with the herbicides considered for invasive plant treatments.

3.6.2 Affected Environment

Many people live near, spend time, work in, drink water from, or depend on forest products from the Olympic National Forest. Several municipal watersheds lie on the Forest (see Soil and Water section in this Chapter). Public concern for drinking water quality in these watersheds is high.

These people may be inadvertently exposed to chemicals from invasive plant management projects on the National Forest. Municipal watersheds, dispersed and developed recreation areas (trailheads, campgrounds, picnic areas, recreation sites, boat ramps, ski areas, work centers, etc) and special forest product collection areas currently occur in the vicinity of invasive plant sites.

All kinds of people gather special forest products such as blackberries, huckleberries, salal, bear grass, mushrooms and herbs, for personal use and commercial sale. Some of these products are target species (blackberries, St. John's wort) but most are not. Special forest product harvesters may have more contact with contaminated vegetation than the general public. A recent unpublished study of commercial permit holders on the Gifford Pinchot National Forest demonstrated that the largest ethnic groups involved with forest product gathering were Hispanics and Southeast Asians (Khmer, Khmer Krom, Laotian and Vietnamese). National Forest System lands are adjacent to other land ownerships; the majority of watersheds on the Forest also contain Olympic National Park, American Indian Lands, commercial forestlands, and other private parcels.

Infested sites are scattered and occupy less than one percent of Olympic National Forest System lands. Invasive plant treatments on the Olympic National Forest are implemented in partnership with the local counties. Crews most often come from the communities in and around the National Forest boundary. Herbicide applicators are well-trained in safe herbicide handling and transportation practices (Lucero presentation May 2005).

3.6.3 Environmental Consequences

Worker Herbicide Exposure Analysis

Herbicide applicators are more likely than the general public to be exposed to herbicides. Worker exposure is influenced by the application rate selected for the herbicide; the number of hours worked per day; the acres treated per hour; and variability in human dermal absorption rates. Appendix Q: Human Health Risk Assessment in the R6 2005 FEIS displayed risks for typical and maximum label rates under a range of conditions. Four potential exposure levels were evaluated for workers, ranging from predicted average exposure (typical application rate-typical exposure variables) to a worst-case predicted exposure (maximum application rate-maximum exposure variables).

In routine broadcast and spot applications, workers may contact and internalize herbicides mainly through exposed skin, but also through the mouth, nose or lungs. Contact with herbicide formulations may irritate eyes or skin.

The ten herbicides proposed for use under the action alternatives, used at rates and methods consistent with PDFs, have little potential to harm a human being. Appendix Q of the R6 2005 FEIS lists the HQ values for all herbicides considered for this project. In most cases, even when maximum rates and exposures are considered, HQ values were below the threshold of concern (HQ values ranged from 0.01 to 1).

Risk assessments indicate concern for worker exposure to triclopyr, especially the Garlon 4 formulation. This is one reason why broadcast application of triclopyr is not allowed under R6 2005 ROD Standard 16. However, a potential worst-case scenario exists exceeding a level of concern for workers given a backpack (spot) application of the Garlon 4 formulation of triclopyr. PDFs eliminate this scenario by favoring use of Garlon 3A, minimizing application rates of all triclopyr formulations, and following safe work practices and label advisories.

For all other herbicides and surfactants, the amount of plausible worker exposure is below levels of concern for all application methods, including broadcast. Project Design Features for all action alternatives reduce both the application rate and the quantity of drift if triclopyr and/or NPE are used. Broadcast of triclopyr is not permitted in any situation (as per Standard 16), and non-NPE surfactants would always be favored where effective.

Chronic (daily over 90 days) worker exposure was also considered in SERA Risk Assessments; chronic exposures also do not amount to levels of concern because the herbicide ingredients are water-soluble and are not retained in the body (they are rapidly eliminated).

Public Herbicide Exposure Analysis

The general public would not be exposed to substantial levels of any herbicides used in the implementation of this project. R6 2005 FEIS Appendix Q considered plausible direct, acute and chronic exposures from herbicide ingredients. Few plausible scenarios exist that exceed even the most conservative threshold of concern for public health and safety. Appendix Q shows Risk Assessment results assuming a human being contacts sprayed vegetation or herbicide or consumes sprayed vegetation, contaminated water, and/or fish.

Direct Contact

There is virtually no chance of a person being directly sprayed given broadcast, spot and hand/select methods considered for this project. A person could brush up against sprayed vegetation soon after herbicide is applied. Such contact is unlikely because public exposure would be discouraged during and after herbicide application. For all herbicides except triclopyr, even if a person were directly sprayed with herbicide applied at typical broadcast rates, chemical exposure would not exceed a level of concern.

Exposures exceeding a conservative level of concern could occur if a person accidentally contacts vegetation spot-sprayed with triclopyr (especially Garlon 4). However, such contact is implausible because no broadcast spraying with triclopyr would occur under any alternative (the R6 2005 ROD added Standard 16 to the Olympic National Forest Plan to only allow spot or hand/selective treatment if triclopyr is used).

The use of Garlon 4 is further limited by the PDFs (for instance, no use of Garlon 4 would be allowed within 150 feet of any water body or stream channel; Garlon 4 would be avoided in special forest product gathering areas, campgrounds, or administrative sites). Public areas, campgrounds and administrative sites would be closed immediately after triclopyr application to eliminate accidental exposures. Project design features such as K1 and K2 require public notification and posting signs about herbicide use to help people avoid inadvertent exposure.

Eating Contaminated Fish, Berries or Mushrooms

The public may also be exposed to herbicide if they eat contaminated fish, berries, or mushrooms (etc). Several exposure scenarios for recreational and subsistence fish consumption were considered in the SERA Risk Assessments; none are near any herbicide exposure level of concern. Fish contamination is unlikely given the Project Design Features that reduce potential herbicide delivery to water.

Members of the public could eat invasive blackberries that have been sprayed, however the target vegetation would quickly be browned and unappetizing. Non-target, native berries or mushrooms may be affected by drift or runoff. Treatment areas would be posted with signs to help people avoid inadvertent exposures.

The R6 2005 FEIS considered exposure scenarios for both short term and chronic consumption of contaminated berries. The herbicide dose from eating a quantity of mushrooms would be greater than for the same quantity of berries (Durkin and Durkin, 2005). The dose, however, would be less than the dose from a dermal contact with sprayed vegetation scenario, and below the threshold of concern (HQ <1).

Appendix Q displayed the exposure scenarios and HQ values associated with eating berries or other herbicide contact. Of the ten herbicides considered in this project, triclopyr remains the single herbicide with exposure scenarios exceeding a level of concern if berries or mushrooms containing herbicide residue are consumed. To respond to this concern, PDFs limit the application methods and rate of application for triclopyr (especially Garlon 4). In addition, under worst-case scenarios and maximum label rates, exposure to NPE surfactant may also exceed a level of concern. Thus PDFs limit the rate of NPE that may be applied. Special forest product gathering areas may be closed to public use immediately after triclopyr application to avoid inadvertent exposure.

People who both harvest and consume special forest products may be exposed both through handling contaminated plant material and chewing or eating it. Chewing and eating contaminated plant material cause different exposure and dose patterns. Such doses would be additive, but are unlikely to exceed a threshold of concern (see cumulative effects, below).

Drinking Contaminated Water

Acute exposures and longer-term or chronic exposures from direct contact or consumption of water, fruit or fish following herbicide application were evaluated in the R6 2005 FEIS. Risks from two hypothetical drinking water sources were evaluated: 1) a stream, which herbicide residues have contaminated by runoff or leaching from an adjacent herbicide application; and 2) a pond, into which the contents of a 200-gallon tanker truck that contains herbicide solution is spilled. The only herbicide scenarios of concern would involve a person drinking from a pond contaminated by a spill of a large tank of herbicide solution. The risk of a major accidental spill is not linked in a cause-and-effect relationship to how much treatment of invasive plants is projected for a particular herbicide; a spill is a random event. A spill could happen whenever a tank truck involved in an herbicide operation passes a body of water. The potential risk of human health effects from large herbicide spills into drinking water are mitigated by Project Design Features that require an Herbicide Transportation and Handling Plan be developed as part of all project safety planning, with detailed spill prevention and remediation measures to be adopted.

Endocrine Disruption

In 2007, the Environmental Protection Agency released a draft list of 73 pesticides, based on the high potential for human exposure, which will be tested for potential to cause endocrine disruption. Glyphosate is the only herbicide considered for use on the Olympic National Forest that is included in the EPA testing. Endocrine disruption and glyphosate was studied by SERA in 2002 (SERA 2002) and considered in the R6 2005 FEIS, Appendix Q.

SERA reported "Three specific tests on the potential effects of glyphosate on the endocrine system have been conducted and all of these tests reported no effects. The conclusion that glyphosate is not an endocrine disruptor is reinforced by epidemiological studies that have examined relationships between occupational farm exposures to glyphosate formulations and risk of spontaneous miscarriage, fecundity, sperm quality, and serum reproductive hormone concentrations… the approach taken in the SERA risk assessment used by the Forest Service is highly conservative and no recent information has been encountered suggesting that this risk assessment is not adequately protective of any reproductive effects that might be associated with glyphosate exposure.

Environmental Justice and Disproportionate Effects

The R6 2005 FEIS found that some minority groups may be disproportionately exposed to herbicides, either because they are disproportionately represented in the pool of likely forest workers, or they are disproportionately represented in the pool of special forest product or subsistence gatherers.

The R6 2005 FEIS suggested that Hispanic forest workers and American Indians may be minority groups that could be disproportionately affected by herbicide use.

Hispanic and non-Hispanic herbicide applicators would be more likely to be exposed to herbicides than other people. Contractors for the Forest and/or County would likely implement herbicide treatments. County invasive plant control departments do not indicate that they employ any specific population group that could be disproportionately affected during invasive plant treatments. Regardless, effects to all County or contract employees engaged in invasive plant control would be negligible due to Project Design Features and compliance with occupational health and safety standards.

People of Hispanic and Southeast Asian (Khmer, Khmer Krom, Laotian and Vietnamese) descent are minority groups that tend to gather mushrooms. However, no mushrooms are target species and Project Design Features are in place to protect fungi. Whenever herbicide treatment is going to happen, the Forest will notify tribes, plant collectors and the general public with media postings, handouts attached to permits, annual tribal contacts and on-the-ground signing (PDFs K1 and K2). Information about invasive plant treatments would be added to existing multi-lingual mushroom gathering permit material to eliminate inadvertent exposures if appropriate. Some areas may be closed to gathering following treatment to avoid exposures. Even given plausible inadvertent exposures, the HQ values would not exceed the threshold of concern.

Direct and Indirect Effects of the Alternatives

No Action

The herbicide applications approved in No Action were previously analyzed in the 1998 EA and found to pose no significant potential risks to health for workers or the public.

Action Alternatives

All alternatives similarly resolve issues related to human health. No individual worker or public exposures of concern are predicted for any alternative. Alternative C has the least risk of adverse effects from herbicide use of all action alternatives because it eliminates or severely restricts herbicide on an estimated two-thirds of the project acreage. However, the Project Design Features, particularly the perennial stream buffers, limitations on application rate of some herbicides also eliminate plausible exposures of concern in Alternatives B and D. No adverse effects to public drinking water supplies or health and safety are predicted in any alternative. Exposures of concern would be minimized on inventoried and currently unknown sites because the Project Design Features would be applied to all situations.

Table 69-How Human Health Concerns are Addressed

Human Health Concern	Project Design Feature to Minimize Exposures of Concern
Workers	Reduced application rates of some herbicides; limitations on broadcast of triclopyr as per Standard 16.
Public	Reduced application rates of some herbicides; limitations on broadcast of triclopyr as per Standard 16. These limitations reduce risks to the general public, even considering multiple exposures.
Special Forest Products	Reduced application rates of some herbicides; posting areas, supplying info to permittees; Using flagging to mark treated areas; Ensuring some areas are available that will not be treated. Detectable impacts are implausible except in the event of an unpredictable exposure. Even multiple exposures (eating contaminated fish, drinking contaminated water, skin irritation) would not result in exposure levels of concern.
Drinking Water	Detectable impacts are implausible except in the event of a spill. Transportation and Handling Safety Plan and Spill Plan.

Cumulative Effects of All Alternatives

The proposed use of herbicides in all alternatives could result in cumulative doses of the same or different herbicides to workers or the general public. Cumulative doses are possible within the context of this project, or when combined with herbicide use on adjacent private lands or home use by a worker or member of the general public.

A person could be exposed to herbicide repeatedly over the course of their lifetime. Appendix Q of the R6 2005 FEIS evaluated chronic exposure scenarios, including repeated drinking of contaminated water, repeated consumption of contaminated berries, and repeated consumption of contaminated fish over a 90-day period. The HQ values for chronic exposures of all herbicides considered for this project were below 1.

A person could be exposed to herbicides by more than one scenario, for instance, a person handling, and then consuming sprayed berries. The cumulative impact of such cases may be quantitatively characterized by adding the HQ values for each individual exposure scenario. An example of this scenario was considered for this cumulative effects analysis: the scenario assumes glyphosate contacts a person's bare skin (HQ for dermal exposure is less than 0.01), and that person immediately eats contaminated berries and fish (HQ values for oral exposure are less than 0.01). Even if these three exposures occurred simultaneously, the combined HQ values are still far below a threshold of concern (HQ < 1).

Some of the herbicides considered for use in this project have HQ values greater than glyphosate; however, the combined HQ values for dermal and oral exposure are still likely to be very low. The body would metabolize some of the initial dose before receiving the second dose, thus reducing the cumulative dose. The risk of adverse effects to human health is low because the herbicides proposed for this project are water-soluble, are quickly eliminated from the body, and do not bioaccumulate in the human body.

Risk assessments indicated a cause for concern about the health effects from exposure to triclopyr; Project Design Features avoid broadcast with this herbicide and severely restrict the use of its more toxic formulation (Garlon 4). In addition, risk assessments indicate a concern regarding use of NPE surfactant. NPE surfactant use is also restricted by the Project Design Features, which would ensure that no thresholds of concern would be exceeded, even if the most ambitious treatment scenario was implemented. All alternatives comply with standards, policies and laws aimed at protecting worker safety and public health.

3.7 Project Costs, Financial Efficiency and Jobs

3.7.1 Introduction

The treatments proposed by the Forest Service are likely to be funded through a variety of mechanisms and partnerships including county, state, federal and private sources. The economic efficiency analysis compares the relative total and average costs of implementing each alternative. Concerns about project cost, financial efficiency, and jobs were expressed during scoping (Issue Group 3).

The differences between alternatives also result in differences in labor force required to complete the work. Members of the public expressed that job creation is a positive indirect effect of the project that should be presented in the EIS.

The following project cost, economic efficiency and job analysis considers the most ambitious conceivable program discussed throughout this chapter. It also characterizes the costs of treating the highest priority infestations found on about 32 percent of the project area (see Chapter 2, Treatment Area Priority). The following assumptions are built into the economic analysis:

- Eradicate/control acres will be harder to treat and will cost 1.5 times as much as containment acres to effectively treat each year.
- Each year's treatment is expected to be 80 percent effective where herbicides are in the range of available methods, and 25 percent effective if herbicide use is severely restricted as in No Action (see Botany and Treatment Effectiveness for rationale for these percentages).
- Alternative B has 34 percent of its herbicide treatment acres modeled for broadcast treatment and Alternative D has 84 percent of its herbicide treatment acres modeled for broadcast treatment. These estimates likely include more broadcasting than would actually occur, based on the nature of the current infestations. However, this assumption helps show the maximum increased efficiency that could be gained by allowing the flexibility gained by relaxing some Project Design Features in Alternative D. Broadcast to spot/hand ratio remains the same in Alternatives D and B through the life of the project.
- Non-herbicide treatments that are combined with herbicide treatments are modeled to start occurring in the second year of treatment. The first year is assumed to be 100 percent herbicide, even though the final prescriptions are likely to include some manual and mechanical treatment during or before herbicide application. This assumption allows for the maximum differentiation between the impacts of herbicide use in the alternatives.
- Over time, the proportion of herbicide use compared to non-herbicide methods is expected to decrease in Alternatives B and D. These alternatives are assumed to follow a pattern of declining herbicide use over time, as shown in Table 70 and Figure 3. No Action and Alternative C maintain the same proportion of herbicide to non-herbicide (13 and 30 percent respectively).

Table 70-Pattern of Herbicide to non-Herbicide over Time, Alternatives B and D

Year	Percent Herbicide Use	Percent Non-Herbicide Use
2007	96%	4%
2008	75%	25%
2009	50%	50%

Year	Percent Herbicide Use	Percent Non-Herbicide Use
2010	0%	100%

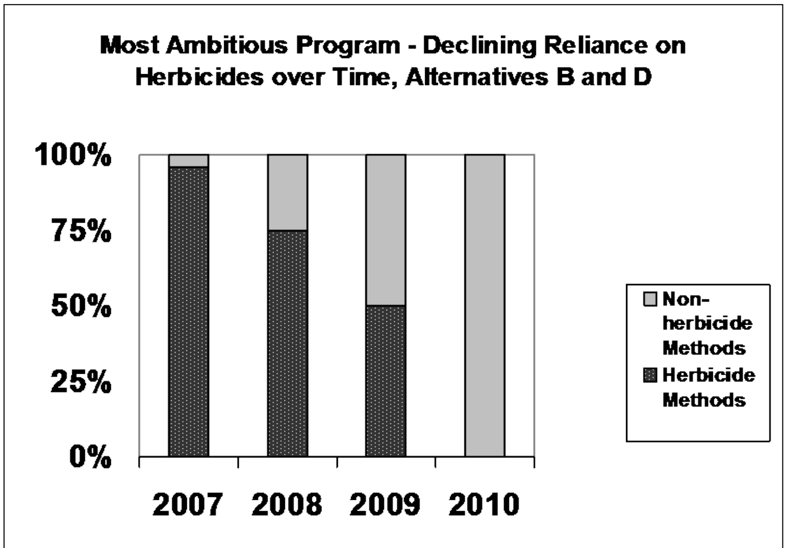

Figure 3-Declining Reliance on Herbicides over Time

3.7.2 Treatment Costs by Method

The following costs were used in the analysis:

- Base cost for broadcast is $100 per acre, increased for eradicate/control by 1.5 to $150
- Base cost for Spot/Hand is $250 per acre, increased for eradicate/control by 1.5 to $375
- Base cost for Manual is $340 per acre, increased for eradicate/control by 1.5 = $460
- Base cost for Mechanical is $100 per acre, increased for eradicate/control by 1.5 to $150
- Annual inventory and monitoring was estimated to cost $20,000 per year.
- Active restoration was estimated to cost about $500 per acre, applied to two-thirds of the project acreage. Active restoration was assumed to occur on approximately 650 acres per year in Alternatives B and D and about 371 acres per year under Alternative C.

Base costs were used for acreage with a treatment strategy of containment, and applied to all acreage treated under No Action.

3.7.4 Total and Average Project Costs

This section reveals the results of the economic analysis, including the total cost of the most ambitious conceivable treatment scenario, projected from 2007 to 2011.

Table 71-Cost Comparisons by Alternative

Alternative	Total Cost 2007-2011	Maximum Annual Cost	Average Annual Cost	Average Cost Per Acre
A (No Action)	$664,000	$255,340	$149,000	$988
B (Proposed Action)	$2,183,000	$751,785	$490,000	$570
C	$3,496,000	$1,247,700	$785,000	$ 1,025
D	$2,070,000	$657,300	$465,000	$540

Table 72 and Figure 4 display the range of annual funding that would be required for the most ambitious treatment scenarios.

Table 72-Estimated Acres Treated and Cost By Year

Year	Acres Treated (Herbicide, Manual, Mechanical)	Cost ($)
No Action		
2007	672	255,340
2008	504	159,110
2009	378	124,430
2010	284	98,350
2011	213	62,260
Proposed Action (Alternative B)		
2007	3,830	751,785
2008	765	532,520
2009	148	376,935
2010	29	342,920
2011	0	311,500
Alternative C		
2007	3,410	1,247,700
2008	1,979	1,169,400
2009	1,133	487,300
2010	657	445,500
2011	381	324,700
Alternative D		
2007	3,830	657,285
2008	765	514,47
2009	148	374,985
2010	29	342,920
2011	0	311,500

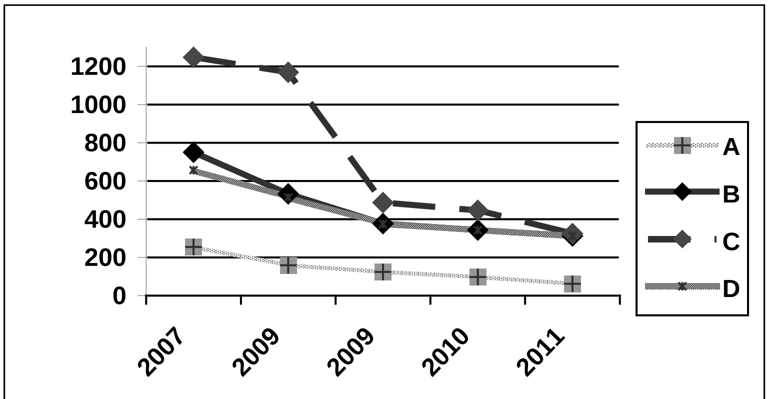

Figure 4-Projected Costs (in Thousands) of Most Ambitious Conceivable Program, 2007-2011, Alternatives A, B, C, and D

The most ambitious treatment scenarios are unlikely to be accomplished, unless funding is increased several-fold. Assuming the current funding estimate of $100,000 was available for invasive plant treatments and restoration each year over five years, approximately 20 percent of the total current infested acreage (750 acres) would be effectively treated. High priority sites would likely be treated, but other infestations would continue to spread. Cost of treating existing infestations would continue to increase.

3.7.3 Jobs by Alternative

Some members of the public expressed that job creation is a valuable indirect effect of invasive plant treatment. They expressed that manual treatments are more likely to involve manual labor than other treatment methods, and thus should be favored. Indeed, nearly all of the costs associated with manual treatments involve labor costs and alternatives with a greater proportion of this treatment compared to other methods would tend to create more jobs per treatment acre.

Assuming full funding, the most ambitious treatment scenarios in each alternative would result in short-term employment opportunities. Employment opportunities would diminish over time as the invasive plants are eradicated, controlled, contained, or suppressed and treated sites are restored.

The alternative comparisons above reflect total estimated costs of labor, equipment, and supplies; these vary depending on treatment type (manual, mechanical, and/or herbicide) and herbicide application method (spot/hand vs. broadcast).

Table 73 displays the assumptions used to determine the number of worker days per year (2007-2011) associated with the most ambitious treatment scenario under each alternative. These assumptions are based on methodology established on the Mount Hood National Forest in their Invasive Plant DEIS (USDA 2006), adapted to local conditions. Wages were estimated as 80 percent of labor cost (assuming the other 20 percent applies to taxes and benefits). Wages were assumed to average of $160 per worker day; actual wages range widely for machine operators, herbicide applicators, and hand laborers.

Table 73-Assumptions for Worker Days per Treatment Acre

Treatment Method	Total Cost Per Acre	Wage Cost as Percent of Total	Worker Day per Containment Treatment Acre	Worker Day per Control/Eradicate Treatment Acre
Herbicide- Broadcast	100	24	.15	.23
Herbicide- Spot/Hand	250	85	1.06	1.6
Mechanical	100	40	.2	.3
Manual	340	100	2	3
Restoration	500	50	1.18	1.18

Table 74-Number of Jobs for First Year of Most Ambitious Treatment Scenario

Alternative	Total Acres	Total Worker Days	Number of Jobs Assuming 6 Month Season
Alternative A	672	1,047	8
Alternative B	3,830	2,320	18
Alternative C	3,410	6,982	54
Alternative D	3,830	1,745	13

Future years' job numbers would decline rapidly after the first year of the most ambitious conceivable treatment, because less treatment would be needed in following years. However, restoration under Alternatives B and D would occur on approximately 623 acres per year in the years 2008 through 2011. Jobs associated with restoration in these years amount to about six additional jobs per six-month year. Restoration under Alternative C would occur on approximately 371 acres per year in the years 2008 through 2011. Jobs associated with restoration in these years amount to about three additional jobs per six-month year.

The project alternatives would require services of 3 to 12 people per six month year over a period of five years, assuming a constant budget of $100,000 per year; following a similar distribution to Table 74. Alternative C creates the most jobs due to its reliance on manual treatment methods.

This job level is not significant to the economy of the counties surrounding the Olympic National Forest, although the most ambitious treatment scenario may require the help of workers from outside the local area.

3.8 Additional Environmental Effects

3.8.1 Heritage (Cultural) Resources

The USDA, Forest Service, Advisory Council on Historic Preservation and the Washington State Historic Preservation Office (SHPO) (Office of Archaeology and Historic Preservation), have a programmatic agreement addressing the management of cultural resources on national forests in the state of Washington (Agreement Number 97-06-59-10). There are several actions that were determined to have little or no potential to affect historic properties. Examples of these actions include fence construction, planting on disturbed areas, aerial seeding, pre-commercial thinning, encroachment thinning using hand methods to lop branches and cut small trees, and reforestation planting by hand.

While invasive plant treatments within the scope of this EIS are not specifically itemized in the Programmatic Agreement between the Forest Service and the Washington SHPO, the techniques, methods and effects are generally similar. Forest Service staff has coordinated with the Washington SHPO and affected Tribes to classify all actions within the scope of this EIS as having no effect on heritage resources.

One exception is weed wrenching of Scotch broom proposed within undisturbed, unsurveyed areas of the National Forest. Such treatments could occur under all action alternatives.

While most Scotch broom infestations occur in disturbed areas (roadsides), some infestations are in less disturbed areas. Weed wrenching of larger-sized Scotch broom has the potential to disturb heritage resources in undisturbed sites. To mitigate for this possible effect, weed wrenching sites would be evaluated by a heritage resource specialist prior to and/or during treatment to eliminate disturbance to heritage resources.

3.8.2 Tribal and Treaty Rights

Several of the tribes are using similar herbicide treatments themselves and support the prescriptions on the forest.

Executive Order 12898 directs the agencies to consider patterns of subsistence hunting and fishing if an action will affect fish and wildlife.

The Chehalis, Jamestown S'Klallam, Hoh, Lower Elwha Klallam, Nisqually, Makah, Port Gamble S'Klallam, Quileute, Quinault, Shoalwater Bay, Skokomish, Squaxin Island and Suquamish Indian Tribes utilize the Olympic National Forest for recreation, hunting, fishing and gathering cultural plants. Minority groups use the forest to collect personal use and commercial forest products like huckleberries, salal, bear grass, mushrooms and herbs. The probability that Alternative B would directly or indirectly affect these people in any way is very low because of the various benign treatments with their built-in Project Design Features and public notifications. The majority of herbicide treatments would be along roadsides. The plants that people come to collect and utilize are usually found in more natural settings vs. a disturbed roadside, so most gathering will occur away from treatment areas. Invasive species would be treated selectively to minimize effects on non-target plants. Cultural plants are would be protected by barriers or avoidance similar to other botanical species of local interest.

No adverse effects are expected on fish and wildlife populations on which the thirteen Indian tribes rely. Many of the tribes have expressed support for herbicide treatments to combat invasive plants because the long-term benefits of controlling the invasive plants outweigh the few short-term risks or disruptions.

3.8.3 Environmental Justice and Civil Rights

Low income and minority groups would see no change to their use of the Forest under this alternative. There currently are no disparate effects on these populations by forest management activities.

Executive Order 12898 directs federal agencies to identify and address the problem of adverse environmental effects by agency programs on minority and low income populations.

Contractors for the Forest and/or County would likely implement herbicide treatments. County invasive plant control departments do not indicate that they employ any specific population group that could be disproportionately affected during invasive plant treatments. Regardless, effects to all county or contract employees engaged in invasive plant control would be negligible given the counties are licensed herbicide applicators that follow label precautions.

3.8.4 Recreation and Scenery

Direct beneficial effects would include the limitation of non-native species in the viewshed, maintenance of diverse community of native grasses, forbs, and shrubs, and maintenance of conditions consistent with the ecological setting that supports the desired landscape character of mosaic forested canopy and grassland openings. The alternative would meet the existing visual quality objectives and be beneficial to the landscape character by reducing risks of altered plant species composition and related effects. The scenic integrity and scenic stability would be maintained.

There are herbicide and manual treatments of invasive plants proposed in campground and recreation residence tracts. The Forest would utilize a notification process so people knew in advance what plants are to be treated, so that people can avoid areas that have been sprayed.

The holders of special use permits for recreation residences on the Forest (e.g., Lake Quinault), are familiar with the problem of invasive plants like English Ivy and knotweed and have been actively engaged in efforts to control the plants around their cabins. Most would likely welcome safe herbicides.

The only negative effect anticipated is if some forest visitors feel they must go elsewhere to avoid chemicals that have been applied to invasive plants in their favorite recreation spot. However, should the public still use the recreation sites just before, during or right after treatment, the risk of an adverse impact to visitors from treated plants is very low (see risk assessment).

Aggressive action proposed to control or eradicate invasive species would help sustain the landscape character with some short term effects to scenic integrity. Dead vegetation would be visible for at least one growing season would be a short-term negative effect. The unnatural appearance of mowed and brushed areas seen from immediate foreground distances (300 feet) would also be a short-term negative effect. Some treatment areas stretch for miles along the sides of roads.

Direct beneficial effects would include the limited amount of non-native species in the viewshed, maintenance of diverse community of native grasses, forbs, and shrubs, and maintenance of conditions consistent with the ecological setting that supports the desired landscape character of mosaic forested canopy and grassland openings. The alternative would meet the existing visual quality objectives and be beneficial to the landscape character by reducing risks of altered plant species composition and related effects. The scenic integrity and scenic stability would be maintained.

The 672 acres of invasive plant treatments currently happening on the forest (No Action, Alternative A) have a manual and mechanical component with some herbicide use (up to 86 acres.) The treatments have not affected recreationists or scenery. Recreation uses have not been displaced by treatments, and the treatments have not led to visual impacts in the form of large areas of dead plants or de-vegetated zones along visually sensitive road corridors.

Alternative A would not keep up with the aggressive invasion of non-native species. Effects to scenic resources would include changing the landscape character to a homogeneous species composition in certain areas and in the forest understory, which is inconsistent with the valued landscape character. The No Action Alternative would not be sufficient to fully maintain the native species. As discussed in Chapter 3.2, native pant species diversity could be reduced. Japanese knotweed may overtake riparian vegetation and river banks altering the scenic pattern, form and texture of open areas and the forest understory extensively. The scenic integrity would be reduced.

3.8.5 Congressionally Designated Areas: Wilderness and Wild and Scenic Rivers

Five wilderness areas occur on the Olympic National Forest, four of these likely contain invasive plants (Buckhorn, Colonel Bob. the Mt. Skokomish and the Brothers Wilderness). The Wonder Mountain Wilderness has a low potential for invasive species. Invasive plants have adverse effects to wilderness values since they disrupt natural processes.

Treatments may also adversely affect wilderness values. Spot and selective herbicide applications, along with manual treatments such as hand pulling, would occur as needed in wilderness areas. Wilderness visitors may notice the effects of invasive plant treatments as browned out vegetation may be obvious. A visitor's sense of solitude may be affected if they came upon an invasive plant worker pulling or spraying individual plants. These encounters would be brief, and no mechanized treatment methods would be approved for wilderness application. The wilderness areas would continue to be free to evolve and respond without interference from invasive plant treatments.

No Wild and Scenic Rivers have been designated on the Olympic National Forests. A number of streams are eligible for consideration under the Wild and Scenic Rivers program, and the Dungeness, Grey Wolf and Duckabush Rivers have been recommended for listing. The overriding resource value being managed for all of the rivers is scenery.

As discussed above, invasive plant treatments with herbicides can temporarily affect scenery if large numbers of target plants are together and are seen in the dying or dead phase. They will not be noticed the following growing season when the residual live, green native vegetation dominates the view.

3.8.6 Energy Requirements and Conservation Potential

No unusual energy requirements are associated with this project. No unusual equipment would be used. Fossil fuels would be used in a prudent manner.

3.8.7 Irreversible or Irretrievable Use of Resources

No irreversible or irretrievable uses of resources are associated with this project. This project restores native vegetation in areas where non-native plants have been introduced. Herbicide treatments in accordance with the alternatives would have relatively short-lived impacts; effects on non-target species would be minimized; such effects would not be permanent.

3.8.8 Effects on Long-term Productivity

Positive effects on site productivity would be expected as native vegetation is restored. Some herbicides have potential to reduce soil productivity; Project Design Features are intended to avoid use of such herbicides where soil productivity is already low.

3.8.9 Consistency with Forest Service Policies and Plans

The proposed project is consistent with all Forest Service policies and existing plans, with the exception of Alternative D, which is associated with herbicide use that has the potential to exceed concentrations of concern for aquatic SOLI. The conclusions and findings in this analysis are supported by the best scientific information available. The FEIS (and the broader scale R6 2005 FEIS to which it is tiered) identifies methods used, discusses responsible opposing views, and discloses incomplete or unavailable information, scientific uncertainty, and risk (See 40 CFR, 1502.9 (b), 1502.22, 1502.24).

Invasive plant treatments are no longer subject to the requirements of the 1989 Mediated Agreement that affected removal of unwanted vegetation in Region Six. The R6 2005 ROD vacated the mediated agreement; replacing it with management direction for invasive plant prevention, treatment, restoration and monitoring. In April 2007, Northwest Coalition for Alternatives to Pesticides, the lead signer in the 1989 Mediated Agreement, agreed it was willing to dissolve the Mediated Agreement for purposes of controlling invasive plants in Region 6. The Portland Audubon Society (July 2, 2007) and the Oregon Environmental Council (October 15, 2007) have also agreed in writing to dissolve the Mediated Agreement for invasive plant control."

3.8.10 Conflicts with Other Plans

No conflicts with existing plans have been noted. Jefferson County reportedly does not use herbicides on lands outside of National Forests (personal communication with Carol Dargatz, Field Trip Notes August 2005). Use of herbicides in this county would be coordinated with the noxious weed board.

“Survey and Manage” species were identified in the 1994 Northwest Forest Plan. In 2001 (2001 ROD) and again in 2004 (2004 ROD), the agencies sought to make changes in this mitigation measure. The 2004 ROD was litigated and on January 9, 2006, Judge Pechman signed an Order that reinstated the 2001 ROD. Thus, the Survey and Management Mitigation Measure currently applies to all species that were included in the program in 2001. Species that were added to the Regional Forester’s Sensitive Species Program in 2004 remain in both programs. Surveys and management protocols required at the time of implementation will be applied.

3.8.11 Adverse Effects That Cannot Be Avoided

Most of the significant issues are resolved through adherence to Project Design Features that minimize or eliminate the potential for adverse effects. However, some adverse effects are inherent to invasive plant treatments and cannot be avoided. These include:

- Taxpayers will likely be responsible for the costs of treatment.
- Herbicide exposures to fish exceeding thresholds of concern are unlikely but possible given an herbicide spill or unpredictable weather event.
- Minor to moderate physical injuries due to forestry work are possible.
- Some common non-target plants are likely to be killed by treatments in close proximity. This is most likely with broadcast herbicide treatments and less likely (but possible) for all other treatment methods. The adverse effects of the invasive plants themselves far outweigh the potential for adverse effects of treatment.

CHAPTER 4. List of Preparers, Consultation and Coordination with Others (Tribes, Agencies)

4.1 List of Preparers

The following people were the primary authors of this EIS. Many other Forest Service employees and others reviewed the document and provided input.

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4.2 Consultation with Regulatory Agencies

The Forest Service has completed consultation with the US Fish and Wildlife Service (FWS) and NOAA Fisheries (NMFS) regarding potential adverse effects on federally listed or proposed Threatened or Endangered Species. The process and results of consultation are discussed at length in Chapter 3.3 and 3.5.

Over the course of 2006 and into early 2007, there were a series of meetings and negotiations between the Forest Service, FWS, and NMFS staff to develop the project description and finalize a Biological Assessment (FWS 2007 BO). The FWS concurred that the project is not likely to adversely affect any federally listed terrestrial wildlife species (FWS LOC, April 2007). FWS and NMFS also prepared letters of concurrence that portions of the project area (away from listed fish habitat) are not likely to adversely affect fish species listed under ESA.

Portions of the project close to listed fish habitat were found likely to adversely affect listed fish species under ESA. However, in their respective Biological Opinions (FWS 2007 BO, NMFS 2007 BO), the regulatory agencies concluded that the action, as proposed, is not likely to jeopardize the continued existence of bull trout, Puget Sound Chinook salmon, Hood Canal summer-run chum, salmon, or Puget Sound steelhead or result in the destruction or adverse modification of designated critical habitat for any listed fish species. The regulatory agencies documented terms and conditions for the project to minimize the taking of any listed fish species. The terms and conditions are consistent with the Proposed Action description in Chapter 2.

Consultation records are available online at the project website: http://www.fs.fed.us/r6/olympic, or hard copy by request.

4.3 Consultation with Tribal Governments

Government to government consultation is ongoing with several tribes including: Chehalis Confederated Tribes, Hoh Tribe, Jamestown S'Klallam Tribe, Lower Elwha, S'Klallam Tribe, Makah Tribe, Port Gamble S'Klallam Tribe, Quileute Tribe, Quinault Indian Nation, Shoalwater Bay Tribe, Skokomish Tribe, Squaxin Island Tribe, and the Suquamish Tribe. Letters have been sent to all tribal chairs, and follow up presentations and meetings have occurred at the request of the tribes.

No tribal members (who have identified themselves as such) have expressed disapproval of the project. In fact, the Quileute Tribe expressed full support of the Forest Service's intention to "address invasive weeds head-on." Informally, tribal representatives have stated they believe the long-term benefits of treating and controlling invasive plants outweigh the short-term risks to localized populations of culturally significant plants.

4.4 Consultation with Counties and Municipal Water Boards

The Forest Service has worked closely with the Clallam, Grays Harbor, Jefferson, and Mason County Weed Boards. County staff have presented information to the Forest Service and participated in field visits. The Counties often implement projects for the Forest Service and other land managers in the area and fully support this project.

Coordination with municipal water boards would occur as a part of implementation planning to ensure compliance with the Olympic National Forest Plan standards and Municipal Watershed Agreements.

4.5 Consultation with Others

Scoping has occurred on this project since 2004. The public has been apprised of project progress through the newspaper, direct mailings, Notices of Intent published in the Federal Register in 2004 and again in 2005, the Forest Schedule of Proposed Actions, informal meetings and discussions, and other media. Many organizations and individuals have expressed interest in the project; everyone who expressed interest was offered a hard copy or CD containing the EIS and Appendices.

The full FEIS and Appendices are also available electronically by website: http://www.fs.fed.us/r6/olympic or on request (see cover page for more information or to request a CD or hard copy).

Hard copies have been distributed to Forest Service offices throughout the area. CDs and hard copies have been sent to the Environmental Protection Agency (who commented during scoping and on the DEIS) and other federal agencies as required. The following is a list of individuals, organizations, agencies and tribal governments and groups to whom this FEIS was sent:

Individuals

Barbara and David Adams
Kenn Adcock
Nancy Alderson
Robert Amundson
Jim Anderson
Lynn Bergeron
Walter Blendermann
B. Boyles
Jack Burkhalter
Jean Cameron
Felix Capoeman
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Jean Dunlop
John Edmundson
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Michelle Franz
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Michael Ryan
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Greg Short
Sandra Smith
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Aubrey Taylor
Cheryl Thoen
Chris Thompson
Ray Triplett
Jim and Barbara Scott Trusky
Roberta Vandehey
Kathryn Venator
Carol Volk
Mitchell Williams

Organizations

German Shorthair Pointer Club
Strategic Analysis
Freres Lumber Co. Inc.
Max Merlich
Black Butte Ranch
Nelson Tree Farm
Mt. Hood Study Group
Lewis and Clark College
Olympic Forest Coalition
Ochoco Lumber Co.
Longevity Herb Company
Greenworks PC Landscape Architecture
American Forest Resource Council
Washington Native Plant Society
The Ptarmigans
Glacier View Enterprises
Portland General Electric
BARK
NCAP
Gifford Pinchot Task Force
Physicians for Social Responsibility
WA State Director
Pacific NW Four Wheel Drive Assoc
Kettle Range Group
NW Ecosystem Alliance

Agencies

Bonneville Power Administration
Environmental Protection Agency Region 10
Wash Dept of Nat. Res.
Mason County Deputy Prosecutor
Wash Nox Weed Board
Olympic National Park
Grays Harbor County Commision
Wash. Dept. of Transportation
Klickitat Cty Nox. Weed Control Brd.
USDI-FWS Nat'l Fish Hatchery
City of Stevenson
USDA, National Agricultural Library
USDI, Office of Environmental Policy and Compliance
County Weed Boards
Municipal Water Boards

Tribal Governments and Groups

Chehalis Confederated Tribes
Hoh Tribe
Jamestown S'Klallam Tribe
Lower Elwha S'Klallam Tribe
Makah Tribe
Port Gamble S'Klallam Tribe
Quileute Tribe
Quinault Nation
Puyallup Tribal Council
Shoalwater Bay Tribe
Skokomish Tribe
Squaxin Island Tribe
Suquamish Tribe
Nisqually Tribe
Point No Point Treaty Council
NW Indian Fisheries Commission

CHAPTER 5. REFERENCES, INDEX, ACRONYMS AND GLOSSARY

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5.2 Index

5.3 Acronyms

a.i. – Active ingredient
ACHP – Advisory Council on Historic Preservation
APHIS – Agricultural Plant Health and Insect Service
AQ – Aquatic
ATSDR – Agency for Toxic Substances and Disease Registry
ATV – All Terrain Vehicle
AWA – Administratively Withdrawn Areas
BCF – Bioconcentration factor
BEE – Butoxyethyl Ester

BIA – US Department of the Interior, Bureau of Indian Affairs
BLM – US Department of the Interior, Bureau of Land Management
BMP – Best Management Practices
BPA – Bonneville Power Administration
CAS – Chemical Abstract Service
CBI – Confidential Business Information
CE – Cumulative Effect
CFR – Code of Federal Regulations
CHU – Critical Habitat Unit
CTWS – Confederate Tribes of Warm Springs
CWA – Clean Water Act
DEIS – Draft Environmental Impact Statement
DEQ – Department of Environmental Quality
DPS – Distinct Population Segment
EDRR – Early Detection/ Rapid Response
EA – Environmental Assessment

EFH – Essential Fish Habitat
EIS – Environmental Impact Statement
ESU – Evolutionary Significant Unit
EO – Executive Order
EPA – Environmental Protection Agency
ESA – Endangered Species Act
FDA – US Food and Drug Administration
FEIS – Final Environmental Impact Statement
FEMAT – Forest Ecosystem Management Assessment Team
FHP – Forest Health Protection
FIRFA – Federal Insecticide, Fungicide, and Rodenticide Act
FSH – USDA Forest Service Handbook
FSM – Forest Service Manual
FWS – Fish and Wildlife Service
FY – Fiscal Year
GIS – Geographic Information Systems
GLEAMS – Groundwater Loading Effects of Agricultural Management
GMA – General Management Area
HQ – Hazard Quotient
ICBEMP – Interior Columbia Basin Ecosystem Management Project
IDT – Interdisciplinary Team
IWM – Integrated Weed Management
LFL – Likely to Cause a Trend to Federal Listing or Loss of Viability
LOAEL – Lowest-Observed-Adverse-Effect Level
LOC – Level of Concern
LSR – Late-Successional Reserve
MA-LAA – May Affect, Likely to Adversely Affect
MA-NLAA – May Affect, Not Likely to Adversely Affect
MI-NLFL – May Impact Individual, but Not Likely to Cause a Trend to Federal Listing or Loss of Viability
MIS – Management Indicator Species
MSDS – Materials Safety Data Sheet
NAA – Not Adversely Affected
NC – Nature Conservancy
NE – No Effect
NEPA – National Environmental Policy Act
NFMA – National Forest Management Act
NHPA – National Historic Preservation Act
NI – No Impact
NIS – Non-Ionic Surfactants
NLAA – Not Likely to Adversely Affect
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration, US Department of Commerce
NOEC – No Observable Effects Concentration
NOAEL – No-Observed-Adverse-Effect Level
NOEL – No-Observed-Effect-Level
NOI – Notice of Intent
NPE – Nonylphenol Polyethoxylate
NRF – Nesting, Roosting and Foraging Habitat
NRIS – National Resource Information System
NVUM – National Visitor Use Monitoring
NWFP – Northwest Forest Plan
ORV – Outstandingly Remarkable Values
OSHA – Occupational Safety and Health Administration
OSS – Oregon Slender salamander
PAYCO – Payments to Counties
PCE – Primary Constituent Elements
PDFs – Project Design Features
PIF – Partners in Flight
POEA – Polyethoxylated Tallow Amine
PPE – Personal Protective Equipment
PVT – Potential Vegetation Type
RfD – Reference Dose
R6 – USDA Forest Service, Pacific Northwest Region (Washington and Oregon)
ROD – Record of Decision
SERA – Syracuse Environmental Research Associates, Inc.
SHPO – State Historic Preservation Office
SMA – Special Management Area
SRI – Soil Resource Inventory
TCP – 3,5,6-Thrichloro-2-Pyridinol
TEA – Triethylamine
TES – Threatened, Endangered and Sensitive species
USDA Forest Service – United States Department of Agriculture Forest Service
USDI – United States Department of the Interior

5.4 Glossary

Active ingredient (a.i.) - In any pesticide product, the component (a chemical or biological substance) that kills or otherwise controls the target pests. Pesticides are regulated primarily on the basis of active ingredients. The remaining ingredients are called "inerts."

Acute effect - An adverse effect on any living organism in which severe symptoms develop rapidly and often subside after the exposure stops.

Acute exposure - A single exposure or multiple brief exposures occurring within a short time (e.g., 24 hours or less in humans). The classification of multiple brief exposures as "acute" is dependant on the life span of the organism. (See also, *chronic exposure* and *cumulative exposure*.)

Acute toxicity - Any harmful effect produced in an organism through an acute exposure to one or more chemicals.

Adaptation - Changes in an organism's physiological structure or function or habits that allow it to survive in new surroundings.

Adapted - How well organisms are physiologically or structurally suited for survival, growth, and resistance to pests and diseases in a particular environment.

Additive effect - A situation in which the combined effects of exposure to two chemicals simultaneously is equal to the sum of the effect of exposure to each chemical given alone. The effect most commonly observed when an organism is exposed to two chemicals together is an additive effect.

Adaptive management - A continuing process of action-based planning, monitoring, researching, evaluating, and adjusting with the objective of improving implementation and achieving the goals of the standards and guidelines.

Adjuvant(s) - Chemicals that are added to pesticide products to enhance the toxicity of the active ingredient or to make the active ingredient easier to handle or mix.

Administratively Withdrawn Areas (AWA) - Areas removed from the suitable timber base through agency direction and land management plans.

Adsorption - The tendency of one chemical to adhere to another material such as soil.

Aerobic - Life or processes that require, or are not destroyed by, the presence of oxygen. (See also, *anaerobic*.)

Affected Environment - Existing biological, physical, social, and economic conditions of an area subject to change, both directly and indirectly, as the result of a proposed human action.

Agent - Any substance, force, radiation, organism, or influence that affects the body. The effects may be beneficial or injurious.

Agency for Toxic Substances and Disease Registry (ATSDR) - Federal agency within the Public Health Service charged with carrying out the health-related analyses under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act (SARA).

Alien species - "With respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem" (Executive Order 13122, 2/3/99). (See also, *invasive*, *noxious*, and *weed species*.)

Allelopathy - The suppression of growth of one plant species due to the release of toxic substances by another plant.

Alluvial - Relating to clay, silt, sand, gravel, or similar detrital material deposited by flowing water. Alluvial deposits may occur after a heavy rain storm.

Ambient - Usual or surrounding conditions.

Amphibian - Any of a class of cold-blooded vertebrates (including frogs, toads, or salamanders) intermediate in many characteristics between fishes and reptiles and having gilled aquatic larvae and air-breathing adults.

Anadromous - Fish that spend their adult life in the sea but swim upriver to fresh water spawning grounds to reproduce.

Anaerobic - Life or process that occurs in, or is not destroyed by, the absence of oxygen. (See also, *aerobic*.)

Anions - Negatively charged ions in solution e.g., hydroxyl or OH- ion. (See also, *cations*.)

Annual - A plant that endures for not more than a year. A plant which completes its entire life cycle from germinating seedling to seed production and death within a year.

Annuity - Payment or receipt of a series of equal amounts at stated intervals for a specified number of time periods. An "annuity due" is a series of equal value outputs or inputs occurring for N equal time periods with "payments" made at the beginning of each period.

Anoxia - Literally, "without oxygen." A deficiency of oxygen reaching the tissues of the body especially of such severity as to result in permanent damage.

Aquatic Influence Zone – The inner half of a Riparian Reserve.

Aqueous - Describes a water-based solution or suspension.

Aquifer - An underground geological formation, or group of formations, containing usable amounts of groundwater that can supply wells and springs.

Arid - A terrestrial region lacking moisture, or a climate in which the rainfall is not sufficient to support the growth of most vegetation.

Background level - In pollution, the level of pollutants commonly present in ambient media (air, water, soil.)

Bacteria - Microscopic living organisms that metabolize organic matter in soil, water, or other environmental media. Some bacteria can also cause human, animal and plant health problems.

Basal application - In pesticides, the spreading of a chemical on stems or trunks of plants just above the soil line.

Base - Substances that (usually) liberate hydroxyl (OH-) anions when dissolved in water and weaken a strong acid.

Benchmark - A dose associated with a defined effect level or designated as a no effect level.

Benthic region - The bottom layer of a body of water.

Benthos - The plants and animals that inhabit the bottom layer of a water body.

Best Management Practices (BMP) - A practice or combination of practices determined by a state or an agency to be the most effective and practical means (technological, economic, and institutional) of controlling point and non-point source pollutants at levels compatible with environmental quality.

Bioaccumulation - The increase in concentration of a substance in living organisms as they take in contaminated air, water, or food because the substance is very slowly metabolized or excreted (often concentrating in the body fat.)

Bioassay - (1) To measure the effect of a substance, factor, or condition using living organisms. (2) A test to determine the toxicity of an agent to an organism.

Bioconcentration - The accumulation of a chemical in tissues of a fish or other organism to levels greater than in the surrounding water or environment.

Bioconcentration Factor (BCF) - The concentration of a compound in an aquatic organism divided by the concentration in the ambient water of the organism.

Biodegradability - Susceptibility of a substance to decomposition by microorganisms; specifically, the rate at which compounds may be chemically broken down by bacteria and/or natural environmental factors.

Biodiversity or biological diversity - The diversity of living things (species) and of life patterns and processes (ecosystem structures and functions). Includes genetic diversity, ecosystem diversity, landscape and regional diversity, and biosphere diversity.

Biological control - The use of natural enemies, including invertebrate parasites and predators (usually insects, mites, and nematodes,) and plant pathogens to reduce populations of nonnative, invasive plants.

Biological magnification - The process whereby certain substances such as pesticides or heavy metals increase in concentration as they move up the food chain.

Biologically sensitive - A term used to identify a group of individuals who, because of their developmental stage or some other biological condition, are more susceptible than the general population to a chemical or biological agent in the environment.

Biomass - The amount of living matter.

Biota or Biome - All living organisms of a region or system.

Body Burden - The amount of a chemical stored in the body at a given time, especially a potential toxin in the body as the result of exposure.

Broadcast application - Herbicide treatment method generally used along roads; boom truck spray is directed at target species. Broadcast methods are used for larger infestations where spot treatments would not be effective.

Bryophytes - Plants of the phylum *Bryophyta*, including mosses, liverworts, and hornworts; characterized by the lack of true roots, stems, and leaves.

Buffer Zone - A strip of untreated land that separates a waterway or other environmentally sensitive area from an area being treated with pesticides.

Candidate species - Those plant and animal species that, in the opinion of the Fish and Wildlife Service (FWS) or National Oceanic and Atmospheric Administration (NOAA) Fisheries, may qualify for listing as "endangered" or "threatened." The FWS recognizes two categories of candidates. Category 1 candidates are taxa for which the FWS has on file sufficient information to support proposals for listing. Category 2 candidates are taxa for which information available to the FWS indicates that proposing to list is possibly appropriate, but for which sufficient data are not currently available to support proposed rules.

Capillary fringe - The zone above the water table within which the soil or rock is saturated by water under less than atmospheric pressure.

Carcinogen - A chemical capable of inducing cancer.

Carrier - A non-pesticidal substance added to a commercial pesticide formulation to make it easier to handle or apply.

Chemical Abstracts Service (CAS) Registry Number - An assigned number used to identify a chemical. Chemical Abstracts Service is an organization that indexes information published in Chemical Abstracts by the American Chemical Society and that provides index guides to help locate information about particular substances in the abstracts. Sequentially assigned CAS numbers identify specific chemicals. The numbers have no chemical significance. The CAS number is a concise, unique means of chemical identification.

Cations - Positively charged ions in a solution. (See also, *anion*.)

Characteristic Landscape - The naturally established landscape within a scene or scenes being viewed.

Chemical Control - The use of naturally derived or synthetic chemicals called herbicides to eliminate or control the growth of invasive plants.

Chronic exposure - Exposures that extend over the average lifetime or for a significant fraction of the lifetime of the species (for a rat, chronic exposure is typically about two years). Chronic exposure studies are used to evaluate the carcinogenic potential of chemicals and other long-term health effects. (See also, *acute* and *cumulative exposure*.)

Chronic Reference Dose (RfD) - An estimate of a lifetime daily exposure level (in mg/kg/day) for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects. Chronic RfDs are specifically developed to be protective for long-term exposure to a compound (seven years to lifetime.)

Chronic toxicity - The ability of a substance or mixture of substances to cause harmful effects over an extended period, usually upon repeated or continuous exposure sometimes lasting for the entire life of the exposed organism.

Code of Federal Regulations (CFR) - Document that codifies all rules of the executive departments and agencies of the federal government. It is divided into fifty volumes, known as titles. Title 40 of the CFR (referenced as 40 CFR) lists all environmental regulations, including regulations for EPA pesticide programs (40 CFR Parts 150-189).

Competitive seeding - Treatment method; most effective after weed populations have been reduced by other control actions.

Congressionally Reserved Areas (CRA) - Areas that require Congressional enactment for their establishment, such as National Parks, Wild and Scenic Rivers, National Recreation Areas, National Monuments, and wilderness. Also referred to as Congressional Reserves. Includes similar areas established by Executive Order, such as National Monuments.

Conifer - An order of the *Gymnospermae*, comprising a wide range of trees and a few shrubs, mostly evergreens that bear cones and have needle-shaped or scale-like leaves. Conifer timber is commercially identified as softwood.

Connected actions - Exposure to other chemical and biological agents, in addition to exposure to a specific pesticide formulation in a field application to control pest organisms.

Contaminants - For chemicals, impurities present in a commercial grade chemical. For biological agents, other agents that may be present in a commercial product.

Control - Means, as appropriate, eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions (Executive

Order 13122, 2/3/99).

Cultural control - The establishment or maintenance of competitive vegetation, use of fertilizing, mulching, prescribed burning, or grazing animals to control or eliminate invasive plants.

Cumulative Effect (CE) - The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions—regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time (40 CFR 1508.7).

Cumulative exposure - Exposure resulting from one or more activities that are repeated over a period of time. (See also, *acute* and *chronic exposure*.)

Detritus - Loose fragments, particles, or grains formed by the disintegration of organic matter or rocks.

Discount - In economics, discounting is the process of carrying an end value backward in time at compound interest.

Distance Zones - Landscape areas denoted by specified distances from the observer. Used as a frame of reference in which to discuss landscape attributes or the scenic effect of human activities in a landscape.

Disturbance - An effect of a planned human management activity, or unplanned native or exotic agent or event that changes the state of a landscape element, landscape pattern, or regional composition.

Dosage/Dose - (1) The actual quantity of a chemical administered to an organism or to which it is exposed. (2) The amount of a substance that reaches a specific tissue (e.g. the liver). (3) The amount of a substance available for interaction with metabolic processes after crossing the outer boundary of an organism.

Dose Rate - In exposure assessment, dose per time unit (e.g. mg/day); also called dosage.

Dose Response - Changes in toxicological responses of an individual (such as alterations in severity of symptoms) or populations (such as alterations in incidence) that are related to changes in the dose of any given substance.

Drift - The portion of a sprayed chemical that is moved by wind off of a target site.

Emergent Vegetation - Plants growing out of or standing in water, in contrast to "submerged aquatic vegetation (SAV)," which grows entirely underneath the waters' surface.

Endangered Species - Any species listed in the *Federal Register* as being in danger of extinction throughout all, or a significant portion, of its range.

Endangered Species Act (ESA) - A law passed in 1973 to conserve species of wildlife and plants, determined by the Director of the U.S. Fish and Wildlife Service or the NOAA Fisheries to be endangered or threatened with extinction in all or a significant portion of its range. Among other measures, ESA requires all federal agencies to conserve these species and consult with the Fish and Wildlife Service or NOAA Fisheries on federal actions that may affect these species or their designated critical habitat.

Endemic - A species or other taxonomic group that is restricted to a particular geographic region due to factors such as isolation or response to soil or climatic conditions. (Compare to "*Indigenous*" and "*Native*.")

Environmental justice - Executive Order 12898 of February 11, 1994 requires federal agencies, to the greatest extent practicable and permitted by law, to make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the commonwealth of the Mariana Islands.

Exposure assessment - The process of estimating the amount of contact with a chemical or biological agent that an individual or a population of organisms will receive from a pesticide application conducted under specific, stated circumstances.

Exotic – Non-native species; introduced from elsewhere, but not completely naturalized. (See also *alien* and *introduced species*.)

Extirpate - To destroy completely; wipe out.

Extrapolation - The use of a model to make estimates of values of a variable in an unobserved interval from values within an already observed interval.

Fauna - The animals of a specified region or time.

Federally listed species - Formally listed as a threatened or endangered species under the Endangered Species Act. Designations are made by the Fish and Wildlife Service or the National Marine Fisheries Service.

Federal Insecticide and Rodenticide Act (FIFRA) Pesticide Ingredient - An ingredient of a pesticide that

must be registered with EPA under the Federal Insecticide, Fungicide, and Rodenticide Act. Products making pesticide claims must submit required information to EPA to register under FIFRA and may be subject to labeling and use requirements.
Fertilization - Treatment method involving adding of nutrients, which could improve the success of desirable species; may be limited, depending on species/soil characteristics.
Flora - Plant life, especially all the plants found in a particular country, region, or time regarded as a group. Also, a systematic set of descriptions of all the plants of a particular place or time.
Foaming - Hot foam is a mechanical method that is effective on seedlings and annuals and can be applied under certain weather conditions, including wind and light rain.
Food chain - A hierarchical sequence of organisms, each of which feeds on the next, lower member of the sequence.
Forage - Food for animals. In this document, term applies to both availability of plant material for wildlife and domestic livestock.
Formulation - A commercial preparation of a chemical including any inerts and/or contaminants.
Fungi - Molds, mildews, yeasts, mushrooms, and puffballs, a group of organisms that lack chlorophyll and therefore are not photosynthetic. They are usually non-mobile, filamentous, and multi-cellular.
Game fish - Species like trout, salmon, or bass, caught for sport. Many of them show more sensitivity to environmental change than non-game fish.
Grazing animals - Treatment method which requires matching the invasive species with the appropriate grazer for best success.
Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) – A model which displays herbicide concentrations in streams under a variety of conditions.
Groundwater - The supply of fresh water found beneath the Earth's surface, usually in aquifers, which often supply wells and springs.
Habitat - The place where a population (e.g., human, animal, plant, microorganism) lives and its surroundings, both living and non-living.
Halftime or half-life - The time required for the concentration of the chemical to decrease by one-half.
Hand/Selective application- Herbicide treatment of individual plants through wicking, wiping, injecting stems, etc., with low likelihood of drift or delivery of herbicides away from treatment sites. This method ensures no herbicide directly contacts soil.
Hand-pulling/Grubbing - Treatment method which is labor-intensive but effective on single plants or on small, low-density infestations.
Hazard Quotient (HQ) - The ratio of the estimated level of exposure to a substance from a specific pesticide application to the RfD for that substance, or to some other index of acceptable exposure or toxicity. A HQ less than or equal to one is presumed to indicate an acceptably low level of risk for that specific application.
Hazard identification - The process of identifying the array of potential effects that an agent may induce in an exposed of humans or other organisms.
Herbaceous - A plant that does not develop persistent woody tissue above the ground (annual, biennial, or perennial.) Herbaceous vegetation includes grasses and grass-like vegetation, and broadleaved forbs.
Herbicide - A chemical preparation designed to kill plants, especially weeds, or to otherwise inhibit their growth.
Humus - Organic portion of the soil remaining after prolonged microbial decomposition.
Tribal and Treaty Rights - Native American treaty and other rights or interests recognized by treaties, statutes, laws, executive orders, or other government action, or federal court decisions.
Indian Tribe - Any American Indian or Alaska Native tribe, band, nation, pueblo, community, rancheria, colony, or group meeting the provisions of the Code of Federal Regulations Title 25, Section 83.7 (25 FR 83.7), or those recognized in statutes or treaties with the United States.
Indigenous - An indigenous species is any which were or are native or inherent to an area. (See also, *native*.)
Inerts - Anything other than the active ingredient in a pesticide product; not having pesticide properties.
Infested area - A contiguous area of land occupied by, in this case, invasive plant species. An infested area of land is defined by drawing a line around the actual perimeter of the infestation as defined by the canopy cover of the plants, excluding areas not infested. Generally, the smallest area of infestation mapped will be 1/10th (0.10)

of an acre or 0.04 hectares.

Integrated Weed Management (IWM) - An interdisciplinary weed management approach for selecting methods for preventing, containing, and controlling noxious weeds in coordination with other resource management activities to achieve optimum management goals and objectives.

Interdisciplinary Team (IDT) - A group of individuals with varying areas of specialty assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad enough to adequately analyze the problem and propose action.

Introduced species - An alien or exotic species that has been intentionally or unintentionally released into an area as a result of human activity. (See also *exotic, invasive, and noxious.*)

Introduction - "The intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity" (Executive Order 13122, 2/3/99).

Invasive plant species - An alien plant species whose introduction does or is likely to cause economic or environmental harm or harm to human health (Executive Order 13122, 2/3/99). (See also *exotic* and *introduced species.*)

Irreversible effect - Effect characterized by the inability of the body to partially or fully repair injury caused by a toxic agent.

Irritant - Non-corrosive material that causes a reversible inflammatory effect on living tissue by chemical action at the site of contact as a function of concentration or duration of exposure.

LC_{50} (Lethal Concentration$_{50}$) - A calculated concentration of a chemical in air or water to which exposure for a specific length of time is expected to cause death in 50 percent of a defined experimental animal population.

LD_{50} (Lethal Dose$_{50}$) - The dose of a chemical calculated to cause death in 50 percent of a defined experimental animal population over a specified observation period. The observation period is typically 14 days.

Label - All printed material attached to, or part of, the pesticide container.

Land allocation - Commitment of a given area of land or a resource to one or more specific uses (e.g. wilderness). In the Northwest Forest Plan, one of the seven allocations of Congressionally Withdrawn Areas, Late-Successional Reserves, Adaptive Management Areas, Managed Late-Successional Areas, Administratively Withdrawn Areas, Riparian Reserves, or Matrix.

Landscape - An area composed of interacting ecosystems that are repeated because of geology, land form, soils, climate, biota, and human influences throughout the area. Landscapes are generally of a size, shape, and pattern which is determined by interacting ecosystems.

Landscape Character - Particular attributes, qualities, and traits of a landscape that give it an image and make it identifiable or unique.

Landscape Setting - The context and environment in which a landscape is set; a landscape backdrop. It is the combination of land use, landform, and vegetation patterns that distinguish an area in appearance and character from other areas.

Leachate - Water that collects chemicals as it trickles through soil or other porous media containing the chemicals.

Leaching - The process by which chemicals on or in soil or other porous media are dissolved and carried away by water, or are moved into a lower layer of soil.

Level of Concern (LOC) - The concentration in media or some other estimate of exposure above which there may be effects.

Lichens - Complex thallophytic plants comprised of an alga and a fungus growing in symbiotic association on a solid surface (such as a rock.)

Littoral zone - (1) That portion of a body of fresh water extending from the shoreline lakeward to the limit of occupancy of rooted plants. (2) The strip of land along the shoreline between the high and low water levels.

Lowest-Observed-Adverse-Effect Level (LOAEL) - The lowest dose of a chemical in a study, or group of studies, that produces statistically or biologically significant increases in frequency or severity of adverse effects between the exposed and control populations.

Manual Control - The use of any non-mechanized approach to control or eliminate invasive plants (i.e. hand-pulling, grubbing.)

Material Safety Data Sheet (MSDS) - A compilation of information required under the OSHA Communication Standard on the identity of hazardous chemicals, health and physical hazards, exposure limits, and precautions.

Mechanical Control - The use of any mechanized approach to control or eliminate invasive plants (i.e. mowing,

weed whipping, hot foam.)
Microorganisms - A generic term for all organisms consisting only of a single cell, such as bacteria, viruses, protozoa and some fungi.
Minimum tool - Use of a weed treatment alternative that would accomplish management objectives and have the least impact on resources.
Mitigation measures - Modifications of actions taken to:

(1) avoid impacts by not taking a certain action or parts of an action;
(2) minimize impacts by limiting the degree or magnitude of the action and its implementation;
(3) rectify impacts by repairing, rehabilitating, or restoring the affected environment;
(4) reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or,
(5) compensate for impacts by replacing or providing substitute resources or environments.

Modification - A visual quality objective meaning human activities may dominate the characteristic landscape but must, at the same time, utilize naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in foreground or middleground.
Mollusks - Invertebrate animals (such as slugs, snails, clams, or squids) that have a soft, un-segmented body, usually enclosed in a calcareous shell; representatives found on National Forest System land include snails, slugs, and clams.
Monitoring - A process of collecting information to evaluate if objectives and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned.
Morbidity - Rate of disease, injury or illness.
Mowing - Invasive plant treatment method which is limited to level/gently-sloping smooth-surface terrain. Treatment timing is critical, and must be conducted for several consecutive years.
National Environmental Policy Act (NEPA) - An Act passed in 1969 to declare a national policy that encourages productive and enjoyable harmony between humankind and the environment, promotes efforts that prevent or eliminate damage to the environment and biosphere, stimulates the health and welfare of humanity, enriches the understanding of the ecological systems and natural resources important to the nation, and establishes a Council on Environmental Quality.
National Forest Management Act (NFMA) - A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring preparation of Forest Plans and the preparation of regulations to guide that development.
National Marine Fisheries Service (NMFS) - The federal agency that is the listing authority for marine mammals and anadromous fish under the ESA.
National Pollutant Discharge Elimination System (NPDES) - As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters.
National Visitor Use Monitoring (NVUM) - A permanent, ongoing sampling system which measures national forest visitor demographics, experiences, preferences, and impressions. A stratified random sample is done for 25% of the National Forest system each year according to a national research protocol. NVUM responds to the need to better understand the use and importance of, and satisfaction with, national forest system recreation opportunities.
National Wilderness Preservation System (NWPS) - The Wilderness Act of 1964 established the national Wilderness Preservation System to ensure that certain federally owned areas in the United States would be preserved and protected in their natural condition. The Act defines a wilderness area, in part, as an area which generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable. Areas included in the system are administered for the use and enjoyment of the American people in such manner as to leave them unimpaired for future use and enjoyment as wilderness.
Native species - With respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem (Executive Order 13122, 2/3/99).
Naturalized - Applied to a species that originally was imported from another country but that now behaves like a

native in that it maintains itself without further human intervention and has invaded native populations.
Non-local native - This term has two meanings: (1) a population of a native plant species which does not occur naturally in the local ecosystem and/or (2) plant material of a native species that does not originate from genetically local sources.
Non-target species - Any plant or animal that is not the intended organism to be controlled by a pesticide treatment.
No-Observed-Adverse-Effect level (NOAEL) - Exposure level at which there are no statistically or biological significant differences in the frequency or severity of any adverse effect in the exposed or control populations.
No-Observed-Effect-Level (NOEL) - Exposure level at which there are no statistically or biological significant differences in the frequency or severity of any effect in the exposed or control populations.
Not Likely to Adversely Affect (NLAA) - Determinations are applied to those species that had very little habitat on National Forests in Region Six, were not in habitats susceptible to invasive plants, or were known to tolerate herbicide treatments without effects.
Noxious weed - "Any living stage (including but not limited to, seeds and reproductive parts) of any parasitic or other plant of a kind, or subdivision of a kind, which is of foreign origin, is new to or not widely prevalent in the United States, and can directly or indirectly injure crops, other useful plants, livestock, or poultry or other interests of agriculture, including irrigation, or navigation or the fish and wildlife resources of the United States or the public health" (Public Law 93-629, January 3, 1975, Federal Noxious Weed Act of 1974).
Outstandingly Remarkable Value (ORV) - A characteristic of rivers or sections of rivers in the national Wild and Scenic River System. In order for a river to be included in the system, it must possess at least one "outstandingly remarkable" value, such as scenic, recreational, geologic, fish, wildlife, historic, cultural, or other similar features. ORV's are values or opportunities in a river corridor which are directly related to the river and which are rare, unique, or exemplary from a regional or national perspective.
Partial Retention - A visual quality objective which in general means human activities may be evident but must remain subordinate to the characteristic landscape.
Pathogen - A living organism, typically a bacteria or virus, that causes adverse effects in another organism.
Percolation - Downward flow or filtering of water through pores or spaces in rock or soil.
Perennial - A plant species having a life span of more than two years.
Periphyton - Microscopic plants and animals that are firmly attached to solid surfaces under water such as rocks, logs, pilings and other structures.
Persistence - Refers to the length of time a compound, once introduced into the environment, stays there.
Personal Protective Equipment (PPE) - Clothing and equipment worn by pesticide mixers, loaders and applicators and re-entry workers, hazmat emergency responders, workers cleaning up Superfund sites, et. al., which is worn to reduce their exposure to potentially hazardous chemicals and other pollutants.
Pest - An insect, rodent, nematode, fungus, weed or other form of terrestrial or aquatic plant or animal life that is classified as undesirable because it is injurious to health or the environment.
Pesticide - Any substance used for controlling, preventing, destroying, repelling, or mitigating any pest. Includes fungicides, herbicides, fumigants, insecticides, nematicides, rodenticides, desiccants, defoliants, plant growth regulators, etc.
Pesticide tolerance - The amount of pesticide residue allowed by law to remain in or on a harvested crop.
pH - The negative log of the hydrogen ion concentration. A high pH (greater than seven) is alkaline or basic and a low pH (less than seven) is acidic.
Population - A group of individuals of the same species in an area.
Population at Risk - A population subgroup that is more likely to be exposed to a chemical, or is more sensitive to the chemical, than is the general population.
Porosity - Degree to which soil, gravel, sediment, or rock is permeated with pores or cavities through which water or air can move.
Potable Water - Water that is considered safe for drinking and cooking.
Project Design Features/Features (PDC, PDF) - A set of implementation Design Features/features applied to projects to ensure that the project is done according to environmental standards and adverse effects are within the scope of those predicted in this Environmental Impact Statement.
Proposed species - Any plant or animal species that is proposed by the Fish and Wildlife Service or NOAA Fisheries in a *Federal Register* notice to be listed as threatened or endangered.

Potential Vegetation Type (PVT) - The term Potential Vegetation Type is used to represent the combination of species that could occupy the site in the absence of disturbance.

Protozoa - Single-celled, microorganisms without cell walls containing visibly evident nuclei and organelles. Most protozoa are free-living although many are parasitic.

Recreational Rivers - A classification within the national Wild and Scenic River System. Recreational rivers are those rivers, or sections of rivers, that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Reference Dose (RfD) - The RfD is a numerical estimate of a daily exposure to the human population, including sensitive subgroups such as children, that is not likely to cause harmful effects during a lifetime. RfDs are generally used for health effects that are thought to have a threshold or minimum dose for producing effects.

Registered Pesticides - Pesticide products which have been approved for the uses listed on the label.

Registration - Formal licensing with EPA of a new pesticide before it can be sold or distributed. Under the Federal Insecticide, Fungicide, and Rodenticide Act, EPA is responsible for registration (pre-market licensing) of pesticides on the basis of data demonstrating no unreasonable adverse effects on human health or the environment when applied according to approved label directions.

Restoration - Ecological restoration is the process of assisting the recovery and management of ecological integrity. Ecological integrity includes a critical range of variability in biodiversity, ecological processes and structures, regional and historical context, and sustainable cultural practices.

Retention - A visual quality objective which in general means human activities are not evident to the casual forest visitor.

Revegetation - The re-establishment of plants on a site. The term does not imply native or nonnative; does not imply that the site can ever support any other types of plants or species and is not at all concerned with how the site ‘functions’ as an ecosystem.

Riparian Area - A geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it.

Riparian Reserves - Areas along live and intermittent streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystem as well, serving as dispersal habitat for certain terrestrial species.

Risk Assessment - An analytic process that is firmly based on scientific considerations, but also requires judgments to be made when the available information is incomplete. These judgments inevitably draw on both scientific and policy considerations.

Risk - The chance of an adverse or undesirable effect, often measured as a percentage.

Risk assessment - The qualitative and quantitative evaluation performed in an effort to estimate the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or biological agents.

Saturated zone - A subsurface area in which all pores and cracks are filled with water under pressure equal to or greater than that of the atmosphere.

Scenery Management - The art and science of arranging, planning, and designing landscape attributes relative to the appearance of places and expanses in outdoor settings.

Scenic - Of or relating to landscape scenery; pertaining to natural or natural-appearing scenery; constituting or affording pleasant views of natural landscape attributes or positive cultural elements.

Scenic Integrity - State of naturalness or, conversely, the state of disturbance created by human activities or alteration. Integrity is stated in degrees of deviation from the existing landscape character in a national forest.

Scenic Quality - The essential attributes of landscape that when viewed by people, elicit psychological and physiological benefits to individuals and to society in general.

Scenic Rivers - A classification within the national Wild and Scenic River System. Scenic rivers are those rivers, or sections of rivers, that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

Seen Area - The total landscape area observed based upon landform screening. Seen-areas may be divided into zones of immediate foreground, foreground, middleground, and background. Some landscapes are seldom seen by the public.

Sensitive species - Species identified by the Regional Forester for which population variability is a concern, as evidenced by significant current or predicted downward trend in population numbers or density; or significant current or predicted downward trends in habitat capability that would reduce a species existing distribution.

Sensitivity Level - A particular degree or measure of viewer interest in the scenic qualities of the landscape.

Species of Local Interest (SOLI) - Threatened, endangered and proposed species; Regional Forester's Sensitive species, management indicator species, and other rare or endemic species of concern.

Species - "A group of organisms, all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms." (Executive Order 13122, 2/3/99).

Spot application - Herbicide treatment involving use of a backpack sprayer or other means. Application is aimed at specific target species, with methods of prevention (such as barriers,) to control damage to non-target species.

Standards and guidelines - The rules and limits governing actions, as well as the principles specifying the environmental conditions or levels to be achieved and maintained.

Sub-chronic exposure - An exposure duration that can last for different periods of time (5 to 90 days), with 90 days being the most common test duration for mammals. The sub-chronic study is usually performed in two species (rat and dog) by the route of intended use or exposure.

Sub-chronic toxicity - The ability of one or more substances to cause effects over periods from about 90 days but substantially less than the lifetime of the exposed organism. Sub-chronic toxicity only applies to relatively long-lived organisms such as mammals.

Submerged Aquatic Vegetation (SAV) - Vegetation that lives at or below the water surface; an important habitat for young fish and other aquatic organisms. In contrast to "emergent vegetation," which is growing out of or standing in water.

Substrate - With reference to enzymes, the chemical that the enzyme acts upon.

Surface water - All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors which are directly influenced by surface water.

Surfactant - A surface active agent; usually an organic compound whose molecules contain a hydrophilic group at one end and a lipophilic group at the other. Promotes solubility of a chemical, or lathering, or reduces surface tension of a solution.

Survey and Manage - Mitigation measure adopted as a set of standards and guidelines within the Northwest Forest Plan Record of Decision and replaced with standards and guidelines in 2001 (Record of Decision) intended to mitigate impacts of land management efforts on those species that are closely associated with Late-Successional or old-growth forests whose long-term persistence is a concern. This mitigation measure applies to all land allocations and requires land managers to take certain actions relative to species of plants and animals, particularly some amphibians, bryophytes, lichens, mollusks, vascular plants, fungi, and arthropods, which are rare or about which little is known. These actions include: (1) manage known sites; (2) survey prior to habitat-disturbing activities; and, (3) conduct extensive and general regional (strategic) surveys.

Synergistic effect - Situation in which the combined effects of exposure to two chemicals simultaneously is much greater than the sum of the effect of exposure to each chemical given alone.

Take - "The term 'take' means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." (Title 16, Chapter 35, Section 1532, Endangered Species Act of 1973)

Threatened species - Plant or animal species likely to become endangered throughout all, or a significant portion of, its range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register.

Threshold - The maximum dose or concentration level of a chemical or biological agent that will not cause an effect in the organism.

Tolerances - Permissible residue levels for pesticides in raw agricultural produce and processed foods. Whenever a pesticide is registered for use on a food or a feed crop, a tolerance (or exemption from the tolerance requirement) must be established. EPA establishes the tolerance levels, which are enforced by the Food and Drug Administration and the Department of Agriculture.

Toxicity - The inherent ability of an agent to affect living organisms adversely. Toxicity is the degree to which a substance or mixture of substances can harm humans or animals.

Toxicology - The study of the nature, effects, and detection of poisons in living organisms. Also, substances that are otherwise harmless but prove toxic under particular conditions. The basic assumption of toxicology is that there is a relationship among the dose (amount), the concentration at the affected site, and the resulting effects.

Treatment Area - An infested area where weeds have been treated or retreated by an acceptable method for the specific objective of controlling their spread or reducing their density.

U.S. Fish and Wildlife Service (US FWS) - The federal agency that is the listing authority for species other than marine mammals and anadromous fish under the ESA.

U.S. Forest Service (USDA FS or USFS) - The federal agency responsible for management of the nation's National Forest lands.

Variety Class - A particular level of visual variety or diversity of landscape character.

Viability - Ability of a wildlife or plant population to maintain sufficient size to persist over time in spite of normal fluctuations in numbers, usually expressed as a probability of maintaining a specific population for a specified period.

Viable Population - A wildlife or plant population that contains an adequate number of reproductive individuals appropriately distributed on the planning area to ensure the long-term existence of the species.

Viewshed - Total visible area from a single observer position, or the total visible area from multiple observer position. Viewsheds are accumulated seen-areas from highways, trails, campgrounds, towns, cities, or other viewer locations. Examples are corridor, feature, or basin viewsheds.

Visual Absorption Capability - A classification system used to denote relative ability of a landscape to accept human alterations without loss of character of scenic quality.

Visual Quality Objective - A desired level of excellence based on physical and sociological characteristics of an area. Refers to degree of acceptable alteration of the characteristic landscape.

Well-distributed - Distribution sufficient to permit normal biological function and species interactions, considering life history characteristics of the species and the habitats for which it is specifically adapted.

Wetland - An area that is regularly saturated by surface or ground water and subsequently is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions. Examples include swamps, bogs, fens, marshes, and estuaries.

Wild and Scenic River System - The Wild and Scenic Rivers Act of 1968 established a system of selected rivers in the United States, which possess outstandingly remarkable values, to be preserved in free-flowing condition. Within the national system of rivers, three classifications define the general character of designated rivers: Wild, Scenic, and Recreational. Classifications reflect levels of development and natural conditions along a stretch of river. Classifications are used to help develop management goals for the river.

Wilderness - Areas designated by Congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped federal land retaining its primeval character and influence without permanent improvements or human habitation. Wilderness areas are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude or for a primitive and confined type of recreation; include at least 5,000 acres, or are of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and may contain features of scientific, educational, scenic, or historical value as well as ecological and geologic interest.

Wild Rivers - A classification within the national Wild and Scenic River System. Wild rivers are those rivers, or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted.